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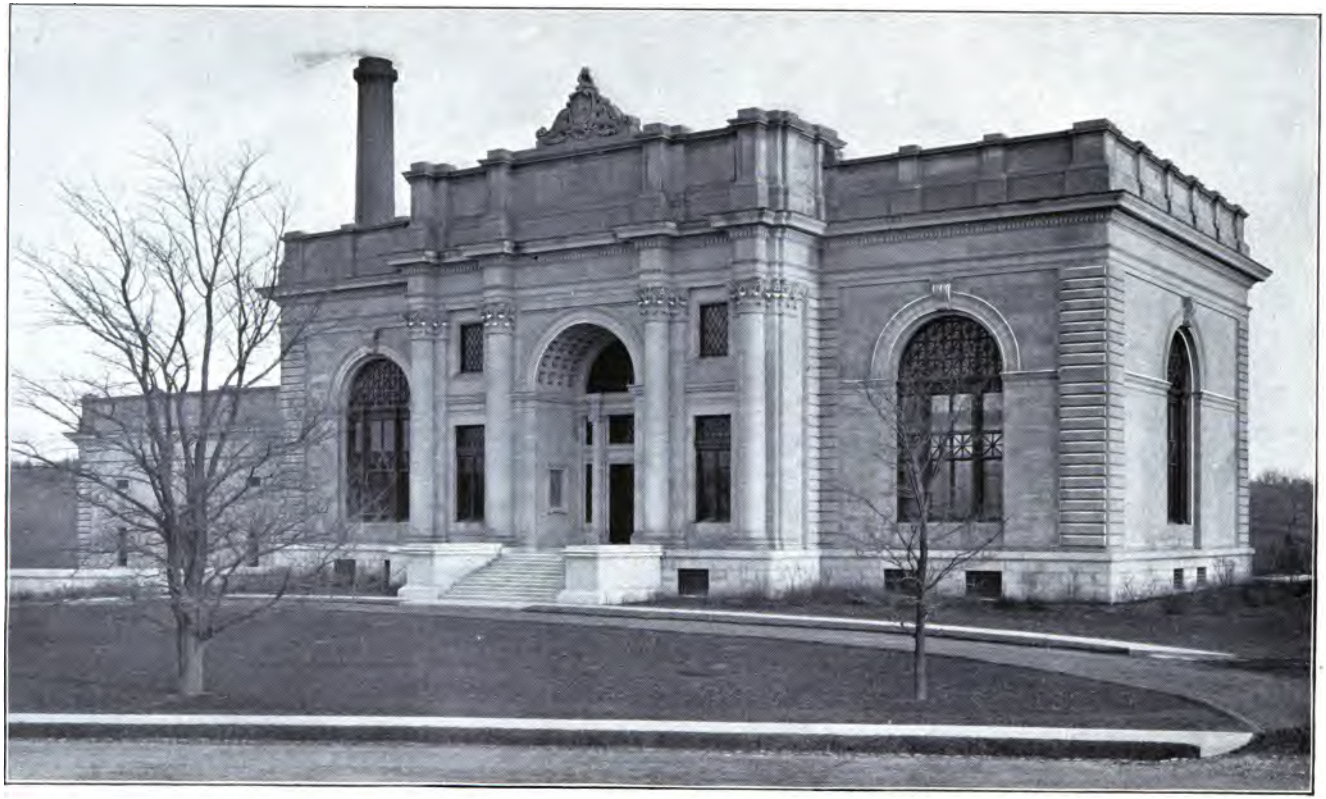

CHESTNUT HILL LOW-SERVICE PUMPING STATION.

Boston - Water

PUBLIC DOCUMENT . . . . No. 57.

SIXTH ANNUAL REPORT

OF THE

METROPOLITAN WATER BOARD.

105645

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METROPOLITAN WATER BOARD.

To the Honorable the Senate and House of Representatives of the Commonwealth of Massachusetts in General Court assembled.

The Metropolitan Water Board, established under the provisions of chapter 488 of the Acts of the year 1895, respectfully submits its

SIXTH ANNUAL REPORT,

being a report of the work and operations of the Board for the year 1900.

I. ORGANIZATION.

(1) ADMINISTRATION.

Henry H. Sprague, whose term of service expired, was reappointed a member of the Board for the term of three years, beginning with the first Monday in May, 1900, and he was designated as chairman. The Board has been constituted as follows: Henry H. Sprague, chairman, Wilmot R. Evans and Henry P. Walcott, M.D. William N. Davenport has continued as the secretary of the Board, and as its executive officer; and Alfred F. Bridgman has also continued as auditor and purchasing agent.

The office force has comprised a book-keeper, an assistant book-keeper, an assistant in auditing, a paymaster, a supply clerk, three stenographers, one messenger and a janitor.

(2) ENGINEERING DEPARTMENT.

The Engineering Department, both for the construction of new works and the maintenance of the works of water supply, has been under the direction of Frederic P. Stearns, the chief engineer.

The principal engineers in service have been as follows: —

Chief Engineer, FREDERIC P. STEARNS.
Consulting Engineers, JOSEPH P. DAVIS, ALPHONSE FTELEY, HIRAM F. MILLS.
Engineer of Distribution Department, DEXTER BRACKETT.
Engineer of Sudbury Department, DESMOND FITZGERALD.
Engineer of Dam and Aqueduct Department, THOMAS F. RICHARDSON.
Engineer of Reservoir Department, HIRAM A. MILLER.
Engineer of Weston Aqueduct Department, HORACE ROPES.
Principal Office Assistant, ALFRED D. FLINN.
Superintendent of Pumping Stations, WILL J. SANDO.*

There have been employed, on construction and maintenance during the year, in the engineering force, in addition to the above, an average of: —

Assistant engineers,	23
Assistant superintendents,	2
Draftsmen,	16
Engineering assistants,	97
Inspectors,	8
Sanitary inspectors,	2
Medical inspectors,	1
Biologists,	3
Clerks,	5
Stenographers,	8
Messengers,	4
Total,	169

The maximum number employed in the engineering force at any one time, including those engaged upon the construction and maintenance of the works, was 193.

Besides the engineering force, which included engineers who have been detailed for purposes of inspection of work, other inspectors over pipe-making, pipe-laying, machinery and masonry have been employed, to the maximum number of 8, and foremen to the maximum number of 18.

The day-labor force, under the general direction of the engineers and the immediate direction of foremen, has been employed in driving sheet piling at the North Dike of the Wachusett Reservoir, upon excavations and preliminary work at the Wachusett Dam, in digging drainage ditches in swamps, making changes in and additions to the Marlborough Brook filter-beds, laying pipes in the Metropolitan Water District, and upon other minor work. The maximum number so employed was 345, that number being employed for the week ending October 6.

---

* Resigned August 31, 1900.

There has also been a maintenance force, averaging 145. The organization of the maintenance force at the end of the year, not including civil engineers, was as follows: —

Dam and Aqueduct Department, including Wachusett Dam and Aqueduct, and Clinton sewerage system,	11
Sudbury Department, including Sudbury and other reservoirs in Sudbury watershed, Marlborough Brook filter-beds, Lake Cochituate, Sudbury and Cochituate aqueducts, and Chestnut Hill Reservoir and surrounding grounds,	50
Distribution Department, including Chestnut Hill, Spot Pond and other pumping stations, Spot Pond and other distributing reservoirs, pipe lines and pipe yards,	83
Total,	144

The maximum force employed by the various contractors at any one time numbered 1,906 men, which was for the week ending on June 30.

(3) CONVEYANCING DEPARTMENT.

This department has been continued under the supervision of Alfred C. Vinton, conveyancer, assisted by George D. Bigelow, assistant conveyancer. Besides the conveyancer and assistant conveyancer, there have been employed at the Boston office Miss Alline E. Marcy, title examiner, and one stenographer. The work at the branch office in Worcester has been carried on under the supervision of the Boston office, with the assistance, for a portion of the time, of Miss Celia M. Tibbetts.

The work in Worcester for the past year has consisted of the examination of about 25 new titles, and the bringing down of old titles to date of settlement, and investigations and labor incident to the recording of executed papers.

The examination of titles in Middlesex County and other districts outside of Worcester County has been conducted from the Boston office.

The preliminary investigations and the purchases of lands for the projected reservoir in Weston, to be built in connection with the new Weston Aqueduct, have required the examination so far of about 20 titles of land in Framingham and Weston.

The Conveyancing Department has been called upon to furnish information necessary for the completion and perfection of the titles, and in the preparation of the various papers required in the 121 settlements which have been effected during the year with land owners on account of lands and easements acquired and depreciation and other damages suffered. These settlements have covered at least 160 different titles. There were, however, in addition 12 settlements pending on January 1, 1901, which have also been completed.

The department has also been called upon to prepare the various instruments required for the takings of lands or easements under the right of eminent domain, and the various instruments for the discontinuance of roads. The takings have been 14 in number, and have been from 194 different owners. The number of discontinuances of roads has been 4.

The Attorney-General has called upon the department to furnish reports in cases for which petitions or suits for damages have been brought, the number of which has increased largely during the past year.

Examinations of the records for liens and other encumbrances, before payments are made upon contracts, have been required, and a great deal of miscellaneous information in regard to real estate is necessarily sought by the different departments.

(4) Police.

The Board has, in accordance with the requirement that it should furnish without charge in all towns in which any work is done under the authority of the Metropolitan Water Act such police protection as may be necessary in consequence thereof, paid for the services of police officers in the towns of Clinton, Boylston, West Boylston and Sterling. These officers have in all cases been appointed by the officials in the various towns in which the work has been carried on, and in the performance of their duties they have been subject to the town authorities.

There were 9 officers thus appointed by the town of Clinton on duty until October 27, when, on account of the additional work carried on in that town, the number was increased to 13, which is the number of officers now paid by the Commonwealth for service in the town. They are all under the control of the chief of police of Clinton, and are additional to the 6 regular officers appointed and paid for by the town.

Owing to the increase in the work in the town of Boylston, 3 additional officers have been appointed by that town for this service, so that there are now 5 officers in all appointed. One of these is a mounted officer, whose maintenance and equipment are also paid for by the Board. A police station is maintained in the town.

One officer is employed in the town of West Boylston, who has charge of the police station, which is used to a considerable extent in general for the various portions of the Wachusett Reservoir district.

There is one mounted officer on duty appointed by the town of Sterling.

The officers in the towns of Sterling, Boylston and West Boylston have each been appointed as special policemen for the other towns. These three towns have no other regular police officers.

The improvements about Spot Pond necessitated additional police service in its vicinity, and, until August 31, 3 additional officers were employed by the Park Commission under the authority of the Board. On September 1 this number was reduced to 1. All these extra officers have been paid for by the Board.

The expenditures for the additional police protection thus afforded within the district where work was in progress have amounted during the past year to $16,062.70; and since the beginning of the work in the year 1895, there has been expended for such police protection, in the various localities where the operations of the Board have been in progress, a total amount of $100,874.16.

No serious cases of disturbance to the people among whom the workmen in the various operations have been employed have been reported to the Board. Good order has been in general maintained in the various localities where the men have worked and lived.

(5) Offices and Buildings.

The Board has continued during the year to occupy the adjoining buildings numbered 2 and 3 Mt. Vernon Street, in Boston, for the purposes of the administrative, engineering and conveyancing departments. Notice, however, was received that this occupancy must cease at the end of the year, as the various buildings in the block at the easterly side of the State House grounds were to be torn down. It became a necessity to arrange somewhat hurriedly for new quarters. The Board leased, for a period of ten years, the buildings numbered 1 and 3 Ashburton Place, at the corner of Somerset Street, on August 13, and proceeded at once to make the alterations and improvements which were necessary in order to adapt these buildings to the purposes of the various departments. As the buildings were old, and had been used for a long period as boarding-houses, the alterations required have been extensive. The buildings have, however, been well adapted to the requirements. They afford excellent light and sufficient space, and they are conveniently accessible to the public and also located but a short distance from the State House.

The office building erected by the Board in Clinton continues to be the headquarters of the Reservoir and Dam and Aqueduct departments.

Branch offices of the Reservoir Department are maintained near the North Dike in Clinton, at Sawyer's Mills in Boylston and at West Boylston.

In connection with the work of the Dam and Aqueduct Department a branch office was maintained at West Boylston until July 25, as headquarters for the party engaged upon investigations relative to the sewerage of the Quinepoxet valley. On September 5 an additional office was established on River Street in Clinton, in connection with the work at the Wachusett Dam.

The branch office in Weston, used by a party engaged upon surveys for the Weston Aqueduct, has been continued throughout the year.

A considerable branch office is maintained for the Engineering Department, in connection with the Sudbury and Cochituate systems at South Framingham.

On October 11, a house in Saxonville, which is now used as the main office of the Weston Aqueduct Department, was leased from the Saxonville Mills for a period of three years, with the privilege of extending the lease a fourth year. This house has been repaired, and a small fire-proof brick vault has been built in connection with it.

The new building at the Glenwood Pipe Yard in Medford, on the line of the Boston & Maine Railroad, which was begun last year, has been completed. This is made the headquarters of the force in charge of the Maintenance Department for the northern part of the District. The building is 101 feet 9 inches long by 37 feet 8 inches wide, and in general is two and one-half stories. It contains offices of the assistant superintendent of the Distribution Department, in charge of pipe lines and reservoirs, and his assistants, and a carpenter's shop, store room and stable. Another building, 109 feet long by 21 feet wide, combining a brick shed, blacksmith shop and store room, has also been erected. Both buildings have been occupied since May 1.

At Chestnut Hill Reservoir are the high-service and low-service pumping stations, a stone stable and several wooden buildings used as a headquarters for the maintenance and repair force for the southern portion of the District.

Other buildings connected with the works and maintained by the Board are the pumping stations at Spot Pond, Arlington and West Roxbury, the Clinton Sewerage Pumping Station at Clinton, the Mystic Pumping Station at Medford, the gate-houses at the several reservoirs, dwellings for attendants, and various buildings for operating purposes.

II. WORK OF CONSTRUCTION.

(1) Wachusett Dam, Reservoir and Watershed.

(a) *Wachusett Dam.*

Studies and investigations have been continued since the organization of the Board for the proper location and design of the great masonry dam which is to be built for the Wachusett Reservoir. The main features of the dam were decided upon early in the year, but many important details were left for more extended consideration, and it was not until August that plans and specifications were completed, so as to call for proposals for its construction. Owing, however, to the rapid increase in the consumption of water and the very dry seasons of 1899 and 1900, it was deemed hazardous to delay altogether the work of excavation until the contract could be made. It was, therefore, decided, prior to making any contract, to begin the necessary excavations. A considerable day-labor force was organized early in July, and was kept at work until the contract for the construction of the dam had been made. The contractors were ready to take up the work of excavation at the point which had been reached by the labors of the day force in the middle of October.

Since the middle of October the contractors have been carrying on the work with considerable vigor. In this way an important beginning has been made, and the work of construction will be diligently prosecuted during the coming season.

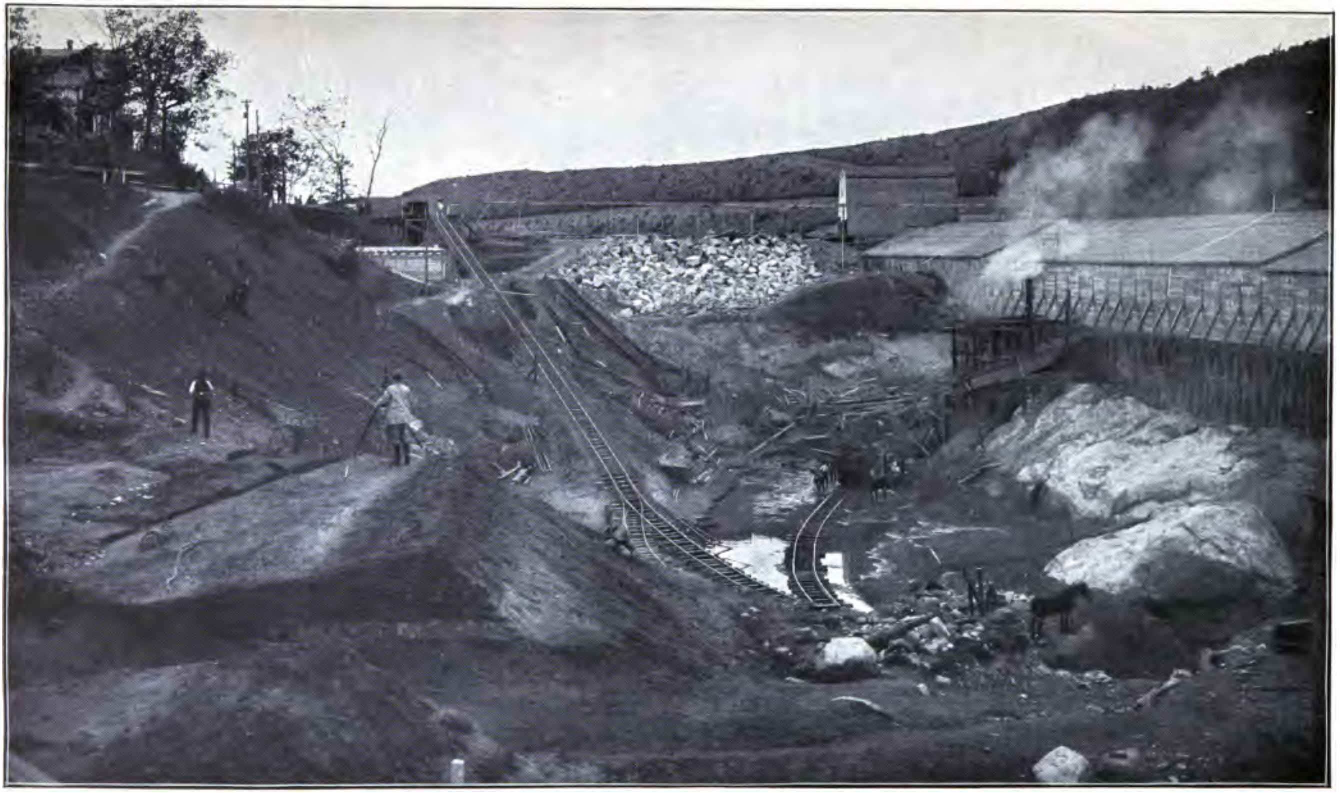
The contract for the building of the dam was made on October 1, 1900, with McArthur Brothers Company of Chicago, Ill., who were the lowest of 11 bidders. The contract amounted, under the estimated quantities of work to be done, to $1,603,635. It is provided that the dam shall be constructed to such a height that considerable water can be stored behind it in the spring of 1903, and that the entire contract shall be completed on or before November 15, 1904.

The masonry dam is to be constructed across the valley, where, at the height of the full reservoir, the distance between the steeply rising slopes will be 1,250 feet. The main dam, which will be carried about 20 feet above the water line, will be about 800 feet long, and will have a height from the lowest point of excavation to the water line of about 179 feet, or a total height of 200 feet. The thickness of the dam at the bottom of the excavation will be about 176 feet, and at the water line will be 25 feet. It will be built of quarried granite laid in cement mortar, and it is expected that the stone will be obtained from quarries on the land of the Commonwealth.

A detailed description of the structure as designed is given in the report of the chief engineer.

An up-stream gate-house within the masonry structure, and a down-stream gate-house directly below it, are to be constructed, by which the water will be drawn from the reservoir as required and carried into the aqueduct, and at which also power can be generated.

A waste weir or spillway extending to the west at an angle with the main dam will be constructed about 450 feet in length, over which the surplus water in time of floods will pass into, and be carried by, a channel about 1,500 feet in length, which is to be excavated, and which will enter the river at a distance of about 800 feet below the dam.



WACHUSETT DAM—PROGRESS OF EXCAVATION AT SITE OF DAM AT BEGINNING OF WORK UNDER CONTRACT.

(b) *Wachusett Reservoir.*

A large amount of work has been done in removing the soil from the bottom of the reservoir and building the North Dike, which is to flank upon the north the masonry dam, and make a barrier in places where the surface of the land is lower than the high-water level of the reservoir.

The removal of the soil has, with one exception, been carried on under contracts which had been previously made. Prior to the year 1900, about 600,377 cubic yards had been removed, involving the stripping of 458 acres of land, constituting about one-eleventh part of the entire amount to be removed. During the year 1900, about 1,678,346 cubic yards have been removed from 900 acres, or about one-fourth part of the entire amount; consequently, 34 per cent. of the estimated total of soil has been removed. There is left to be removed nearly 4,000,000 cubic yards and about 2,842 acres to be stripped. The existing contracts provide for about one-half of this work.

A small portion of this soil has been used for road embankments and for filling shallow flowage, but by far the larger part has been used in the construction of the North Dike, to which it is conveyed principally by locomotives and cars.

The larger part of the main cut-off trench at the dike has been completed. This trench extends longitudinally a distance of 9,356 feet, with a width of 30 feet at the bottom, increasing as it rises, and a maximum depth of 60 feet, from which the gravel and coarser sand have been removed. The sheet piling, which has been driven in the bottom of the trench for a distance of 5,245 feet at the deeper portions, has been completed, and the work of filling the trench with the impervious soil brought from the bottom of the reservoir has been far advanced.

A secondary cut-off trench along the deeper portions of the line of the dike has been dug and completely filled with soil in a similar manner.

The steeper embankment of sand and gravel, which is to constitute the dike on the water side, and which is to have a length, at full reservoir level, of 10,498 feet, and to have a height of 17 feet above the reservoir level, has been carried up far towards completion; and a large amount of soil has been deposited to constitute the long embankment on the outer side, which at its farthest point extends from the top of the dike a distance of 1,730 feet.

(c) *Construction and Discontinuance of Roads.*

Considerable progress has been made in the improvement of old roads and in the construction of new roads around the reservoir to take the place of roads discontinued or to be discontinued.

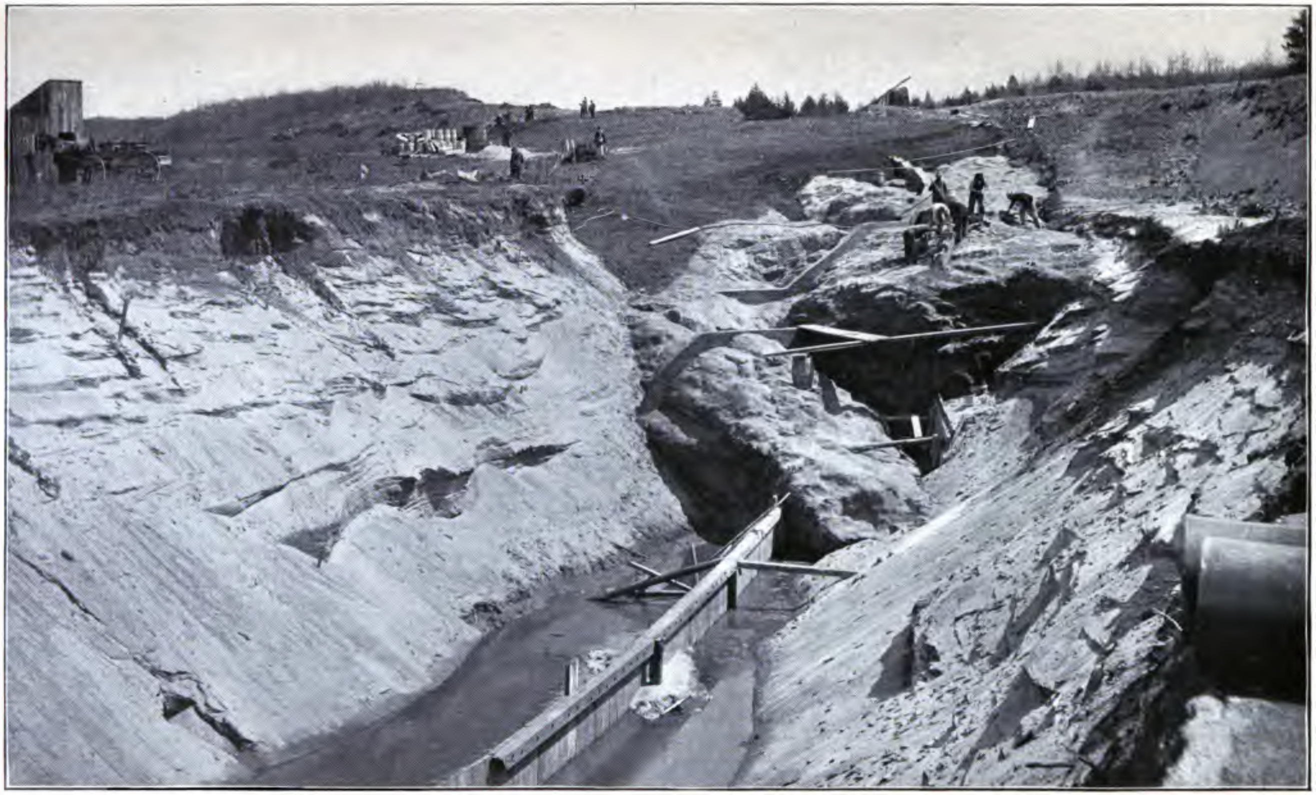
The new road from Boylston Centre to West Boylston, and the extension therefrom leading toward Shrewsbury, the location for which was determined by a decree of the Massachusetts Highway Commission, have been completed for a distance of 15,050 feet, and Temple Street in continuation has been improved for a distance of 5,099 feet. The entire road-bed for a distance of 20,149 feet has been surfaced with broken stone. The contract work in connection with these roads, not including some slope paving and the guard fences, has cost a total of $77,003.73.

The improvement of Lancaster Street in West Boylston on the northerly side of the reservoir, a distance of 8,508 feet, and the construction of a new road extending 13,607 feet from Lancaster Street toward Clinton, have been completed, and they were approved by the county commissioners on June 19, 1900.

Much work has been done toward the location of a new road from Lancaster Street to Oakdale, and plans and estimates for a portion of the distance have been prepared; but the northerly portion of the road as it approaches the village of Oakdale cannot be definitely located until the location of the Central Massachusetts Railroad has been determined.

Progress has been made in making surveys and investigations for the new highway which is to cross the Wachusett Reservoir between West Boylston and South Boylston, and in the making of minor improvements in other parts of the reservoir district.

As the work of construction of the Wachusett Reservoir has progressed, it has become necessary to discontinue several of the roads in Clinton, Boylston and Sterling. The new roads which have been built at the northerly and southerly sides of the reservoir have in part taken the places of the discontinued roads. Other roads lay in the district which is to be submerged. Some were discontinued prior to the year 1900, but the larger part of the discontinuances have taken place during the past year.



WACHUSETT RESERVOIR—Portion of NORTH DIKE, showing Main Cut-off Trench with Sheet Piling and Treatment of Ledge.

The following is a list of the roads, with dates of discontinuance, which have been discontinued by the Board on account of the operations in the construction of the Wachusett Reservoir: —

LOCATION.	Description.	Date of Discontinuance.
Clinton, . . .	Road skirting the northerly side of Sandy Pond, between the South Meadow Road and South Main Street.	September 8, 1898.
Clinton and Boylston, .	Southerly part of South Main Street in Clinton, together with the road leading southerly therefrom, to a point in the River Road in Boylston.	September 8, 1898.
Boylston, . . .	Road between Sawyer's Mills and the South Clinton station.	July 10, 1899.
Boylston, . . .	Road or way leading southeasterly from the preceding road to the River Road.	July 10, 1899.
Clinton and Boylston, .	Part of River Street and of the River Road, between Oak Street in Clinton and the old road from Sawyer's Mills to West Berlin, near the South Clinton station in Boylston.	December 30, 1899.
Clinton and Boylston, .	Part of the County Road from Clinton to Northborough, running over Ball Hill, between the River Road and the new highway from Clinton to Boylston built by the Metropolitan Water Board on the southerly side of the reservoir.	December 30, 1899.
Clinton and Boylston, .	That part of the road known as Boylston Street which lies between the new highway on the southerly side of the reservoir and the road to West Berlin.	December 30, 1899.
Clinton, . . .	That part of the South Meadow Road which lies between the new highway from Clinton to West Boylston on the northerly side of the reservoir and the old road from Clinton to West Boylston.	June 22, 1900.
Clinton and Boylston, .	That part of the old road leading from Clinton to West Boylston, from the South Meadow Road to the road from Sawyer's Mills to Sterling.	June 22, 1900.
Boylston, . . .	That part of the old road from Clinton to West Boylston mentioned in preceding discontinuance, between the point of discontinuance and the road from Boylston Centre over Scar Bridge to Sterling.	December 15, 1900.
Boylston, . . .	That part of the road in continuance of Bruce Street in Boylston, which lies between West Boylston line and the old road from Clinton to West Boylston.	December 22, 1900.
Boylston and Sterling,	That part of the road from Boylston Centre leading by the Boylston railroad station to Sterling, which lies between a cross road leading to the road from Clinton to Boylston Centre and a point in Sterling near the new northerly highway.	December 15, 1900.
Boylston, . . .	A road between the road running from Boylston Centre to Sterling, mentioned in preceding discontinuance, and the road from Boylston Centre to Clinton.	December 15, 1900.
Boylston, . . .	Road near Sawyer's Mills between the road running from Boylston Centre to Sterling and the road from Clinton to West Boylston.	December 15, 1900.
Boylston, . . .	That part of a road running northerly from the Scar Bridge Road, which extends from land formerly of Charles A. Hunt to the northerly end of the road in land formerly of John F. O'Brien.	December 15, 1900.

(*d*) *Relocation of the Central Massachusetts Railroad.*

Under the provisions of the Metropolitan Water Act, that the Board may make such relocation of the Central Massachusetts Railroad "as, and in such manner as, shall be mutually agreed upon by said water board and the board of directors of the railroad company; and if they cannot agree thereon, then as, and in such manner as, shall be determined on the application of either party, in writing, by the board of railroad commissioners," conferences had been had with the authorities of the Boston & Maine Railroad, the lessee of the Central Massachusetts Railroad Company, previous to the current year, and it was believed that decided progress had been made toward a mutual agreement. The complications which have subsisted between the companies have made it impossible for the Board to make any definite arrangement. It is hoped that it will be possible to reach a satisfactory result soon, inasmuch as the progress of the work will make it necessary in some way to determine the matter during the coming year, and to begin the construction of the railroad as relocated.

(*e*) *Clinton Catholic Cemetery.*

The St. John's Catholic Cemetery in Clinton, being included within the limits of the proposed reservoir, and the removal of the bodies there buried having become necessary, a tripartite agreement had been made on July 1, 1898, between the Board, the Roman Catholic Bishop of Springfield, who was the owner of the fee of the old cemetery, and the St. John's Catholic Cemetery Association, which had been organized for the purpose of acquiring and maintaining a new cemetery to take the place of the old one. By this agreement lands in the southerly part of Lancaster were to be acquired to receive the bodies buried in the old cemetery and to become a new burial place for the St. John's parish, and conveyance was to be made to the Commonwealth of the old cemetery site. In order to overcome some difficulties which had arisen among the parties interested in the cemetery, the Board, on February 8, 1899, consented to a supplementary agreement, by which the work of the removal of the bodies should be accomplished under the direction of a committee composed of the officers of the Association and representatives of the lot owners, instead of being done directly by the Association.

Under these agreements the lands in Lancaster were purchased, and about 69.75 acres were, at the request of the parties, conveyed, for the time being, to the Commonwealth. A small tract of about 2.15 acres was conveyed directly to the Association. The land acquired was beautifully located, had a sandy soil well adapted for the purposes, and was covered with wood and timber. Drives and roads throughout the tract have been graded and constructed, aggregating in length 7,475 feet, and adequate lots have been skilfully laid out and surfaced with loam. The removal of the bodies began on December 19, 1899, and 157 bodies had been reinterred at the end of the year, when, on account of the weather, the work was suspended.

Operations were resumed early in the spring and prosecuted with vigor until September 1, 1900, when all bodies known to be buried had been removed. The total number of bodies which have been removed is 3,816. A very few bodies whose burial place had not been marked were subsequently discovered on the removal of the earth and soil.

The laying out of the grounds of the new cemetery and its preparation as a burial place, and the removal of bodies from the old cemetery to the new cemetery, have been under the charge of Harold Parker, who was selected as engineer by the Cemetery Association, and whose appointment was confirmed by the various parties concerned. The work has been accomplished with general satisfaction.

There has been paid over in the purchase of lands $11,678.66; for the preparation of the new cemetery, $19,030.65; and for the removal of bodies, $29,443.86; leaving to be paid the balance of $32,346.83, upon the conveyance to the Commonwealth of the old cemetery lot, and the delivery to the Commonwealth of a release and discharge of damages.

The executive committee in charge of the removal of bodies and Mr. Parker, the engineer, have notified the Board that the work of removal has been accomplished, and our engineer has certified that the bodies found in the old cemetery, as well as monuments and other structures, have been removed in accordance with the agreements. So far as the Board is concerned, matters are ready for a final settlement; and on receipt of a deed of the old cemetery lot and a release of all damages and claims as provided by the agreement, the Board is ready to convey the lands held by it and included within the new cemetery lot to the St. John's Catholic Cemetery

Association, as provided for, and to pay over the balance due under the agreement.

The new cemetery is spacious, well arranged and finely located, and it is acknowledged that few towns in the Commonwealth possess a more attractive burial place.

A copy of the report made by Harold Parker, the engineer, to the committee appointed for the removal of the bodies, which has been transmitted to the Board, is published as an Appendix.

(*f*) *Sanitary Inspection of Works of Construction.*

A considerable inspection as to the sanitary condition of houses and camps in which laborers have lived, and of the grounds upon which the work is carried on within the limits of the Wachusett Reservoir, has been maintained. Dr. John J. Goodwin of Clinton has continued in regular employment as a medical inspector, and has acted in connection with the sanitary inspectors of the Board; and during a portion of the year one of the engineering staff was also assigned to assist the inspectors. There were a few cases of typhoid fever in the watershed, but these were not among the laborers employed in the work. The various buildings and camps occupied by contractors and their employés have been kept in fair condition, and the general health of the people dwelling on the watershed, as well as of those employed in the work, has been good.

(*g*) *Financial Summary.*

The following is a summary showing the purposes of expenditures on account of the Wachusett Dam and Reservoir: —

	For the Year ending December 31, 1900.	From Beginning of Work, and ending December 31, 1900.
Contracts for construction, ...	$580,899 95	$975,750 74
Real estate: —		
Mill property and water rights, . . .	30,000 00	1,340,700 00
Other property for reservoir and margins, .	144,370 34	1,052,134 41
Outlying property, ...	6,335 00	26,012 66
Damages to real estate not taken, to business, and on account of loss of wages, . . .	68,289 23	112,397 91
Engineering, ...	103,245 89	340,345 99
Preliminary and additional work, taxes and other expenses, ...	148,184 50	557,387 06
Totals, ...	$1,081,324 91	$4,404,728 77

(2) WACHUSETT AQUEDUCT.

The Wachusett Aqueduct was regarded as completed prior to the year 1900, but certain amounts have been paid out during the year for engineering and additional work, and also in settlement of real estate damages which had not previously been disposed of.

There are 9 claims pending under which suits have been brought for damages on account of taking of lands for the aqueduct. There are in addition 2 or 3 cases in which parties have failed to bring suit within the time required by the statute.

The following table shows the purposes of the expenditures on account of the Wachusett Aqueduct: —

	For the Year ending December 31, 1900.	From Beginning of Work, and ending December 31, 1900.
Contracts for construction,	-	$1,446,403 39
Real estate settlements,	$8,271 00	68,712 40
Engineering,	1,377 06	162,632 17
Preliminary and additional work and other expenses,	4,158 45	99,563 71
Totals,	$13,806 51	$1,777,311 67

(3) NASHUA MEADOWS.

An extended investigation has been made of the effect produced by the decreased flow of water upon the lower lands and meadows situated in Clinton, Lancaster, Harvard and Bolton, below the more inhabited portions of the town of Clinton. Early hearings were given to the owners of many of these lands, who made claims that great injury resulted from the loss of the fertilizing advantages which had come from the greater overflow of the lands in the periods of spring freshets and from the necessity which had arisen for building division fences. Some of the people in the district affected, however, have stated that, in their opinion, their lands would not be injured, but would even be benefited, by the lack of freshets and overflow. At the beginning the question of damages was one of belief, and not of evidence. The Board has had extensive examinations made, not only by its own engineers, but also by practical farmers and land owners in the neighborhood, and has sought the best experts whom it has been able to obtain. The Board informed the claimants that it would welcome any facts or expert opinions in their possession, or which they might be able to furnish. The examinations have extended so far over two seasons, one of which was of almost unprecedented dryness, and the other afforded freshets of almost unprecedented character. Many investigations have been made each season, and the Board has received careful and painstaking reports. While the Board has desired to make good any damages resulting to these owners, it has thus far been unable to obtain evidence showing an actual injury, or such probability of injury in the future as to justify it in the payment of damages under these claims.

(4) SUDBURY DAM AND RESERVOIR.

Little construction has been done during the year in the Sudbury Department. Some work in connection with the improvement of the Marlborough Brook filter-beds and the drainage of swamps has been accomplished by the department, and is described in another place.

The grounds below the Sudbury Dam have been graded and planted. The building formerly occupied as an office for the department has been removed to a more appropriate location and received considerable improvement and addition, and is occupied by the foreman and his assistant in direct charge of the dam and this portion of the reservoir.

A masonry storehouse has been constructed at the northerly end of the dam, for the storage of stop planks, and of boats, tools and coal.

The Sudbury Dam and Reservoir have now been transferred from the construction to the maintenance department, and they are placed under the general supervision of the assistant superintendent at the South Framingham office.

The remaining claims for damages on account of the taking of lands for the reservoir have been settled.

The following is a summary of the purposes of the expenditures made on account of the Sudbury Dam and Reservoir: —

	For the Year ending December 31, 1900.	From Beginning of Work, and ending December 31, 1900.
Contracts for construction,	–	$1,949,448 77
Land settlements,	$1,349 00	620,692 43
Engineering,	537 48	172,913 85
Preliminary and additional work and other expenses,	977 04	177,054 41
Totals,	$2,863 52	$2,920,109 46

(5) PROTECTION AND IMPROVEMENT OF WATER SUPPLY.

(a) *Marlborough Brook Filter-beds.*

Though the operation of the Marlborough Brook filter-beds has in general proved satisfactory, it has been found desirable to enlarge the main channel and also to provide more storage room for the unusually large flow of water which occurs from this watershed in times of freshets. Additional storage has been gained, the main channel has been widened, and additional inlets to the beds have been provided. Considerable has been accomplished in the prevention of the adhesion of the ice to the bottom of the beds, and other general improvements have been effected.

The expenditures on account of the Marlborough Brook filter-beds and the protection of the brook from pollution, including work done by the city of Boston, are as follows: —

	For the Year ending December 31, 1900.	From Beginning of Work, and ending December 31, 1900.
Contracts for construction,	$3,635 16	$53,441 32
Land settlements,	–	37,626 32
Engineering,	1,943 82	16,775 52
Preliminary and additional work and other expenses,	5,455 53	8,572 15
Totals,	$11,034 51	$116,415 31

(b) *Disposal of the Sewage of the City of Marlborough.*

Trouble has arisen within the past two or three years by reason of a defect in the sewerage system of the city of Marlborough, through which the surface water in a low district of considerable extent in that city, in times of large rains, is caused to flow directly into the sewers, which, though adequate for sewerage purposes, are not large enough to carry away in addition the surface water in periods of freshets. The result has been that at times the sewers have overflowed, and sewage in connection with the surface water has been carried down the brook at times when, owing to the floods, the filter-beds were unable to dispose of the whole, and, consequently, sewage and other objectionable substances have entered directly into the reservoir. The trouble has seemed to the Board upon investigation to result from the want of measures being taken by the city of Marlborough to dispose properly of the surface water. The Board, therefore, has called upon the city to take action to prevent the pollution of the water supply. A considerable improvement has been accomplished in the district affected by the inspectors of the Board acting in co-operation with the Marlborough board of health. Further and more radical improvements should be made, not only to prevent the pollution of the Sudbury water supply, but also to relieve the district above mentioned from a serious trouble.

(c) *Swamp Drainage.*

The operations which were in progress for the drainage of swamps, both in the Sudbury and Wachusett watersheds, during the preceding year, have been carried out, and some additional work has been performed. The results accomplished in improving the quality of the water have been very satisfactory. The amount which has been paid in land damages has been almost insignificant in proportion to the work which has been accomplished, and in general the work of drainage has been of advantage to the owners of the lands which have been drained as well as to the Metropolitan water system.

The following table shows the amount of work done in the two watersheds: —

	Acres of Swamp drained.	Length of Ditches.	
		Feet.	Miles.
Wachusett watershed, ...	132	15,048	2.85
Sudbury watershed, ...	937	129,510	24.53
Totals, ...	1,069	144,558	27.38

The following is a summary of the expenditures on account of swamp drainage and other work for the improvement of the Sudbury and Wachusett watersheds: —

	For the Year ending December 31, 1900.	From Beginning of Work, and ending December 31, 1900.
Day work in construction,	$13,246 13	$60,436 41
Land settlements,	1,269 60	10,941 10
Engineering,	9,410 85	27,094 60
Other expenses,	124 02	859 77
Totals,	$24,050 60	$99,331 88

(*d*) *Disposal of Sewage from the Quinepoxet Valley.*

For the purpose of determining the character of the manufacturing wastes and sewage and other causes of pollution existing, or likely to exist in the future, in the small manufacturing villages in the Quinepoxet valley, and for determining the best methods for taking care of such polluting materials, sites for filter-beds have been carefully examined and main lines of sewer have been located. No definite plans, however, have yet been made for undertaking these improvements.

(*e*) *Main Sewer in Framingham.*

The Board in the latter part of the year entered into an arrangement with the town of Framingham for the construction of a new main sewer in that town along the valley of Beaver Dam Brook, a tributary to Lake Cochituate. At the time that the Framingham sewerage system was originally built, a considerable sum was contributed by the city of Boston toward the payment of its cost, in order that the system should be so constructed as to remove the sewage beyond the boundaries of the Cochituate watershed. Recently, however, several manufacturing establishments have been built in this valley upon lands so low that the town sewers could not remove the sewage, and, in order to conform to the requirements of the law, a new main sewer became necessary.

After investigation and conference with the authorities of the town, the Board deemed it just to contribute the sum of $9,000 toward the construction of this sewer by the town, that sum being estimated as one-half of the entire amount required for its construction, the town agreeing to construct the sewer within a year, to make no claim upon the Commonwealth for further contribution for the construction or maintenance of this sewer and such other sewers as should be constructed tributary thereto, or on account of the disposal of the sewage, whether such sewers should be located in the town of Framingham or the town of Sherborn. This arrangement was deemed satisfactory by both sides, and the town of Framingham has entered vigorously into the construction of the main sewer, as agreed.

(6) Chestnut Hill Low-service Pumping Station.

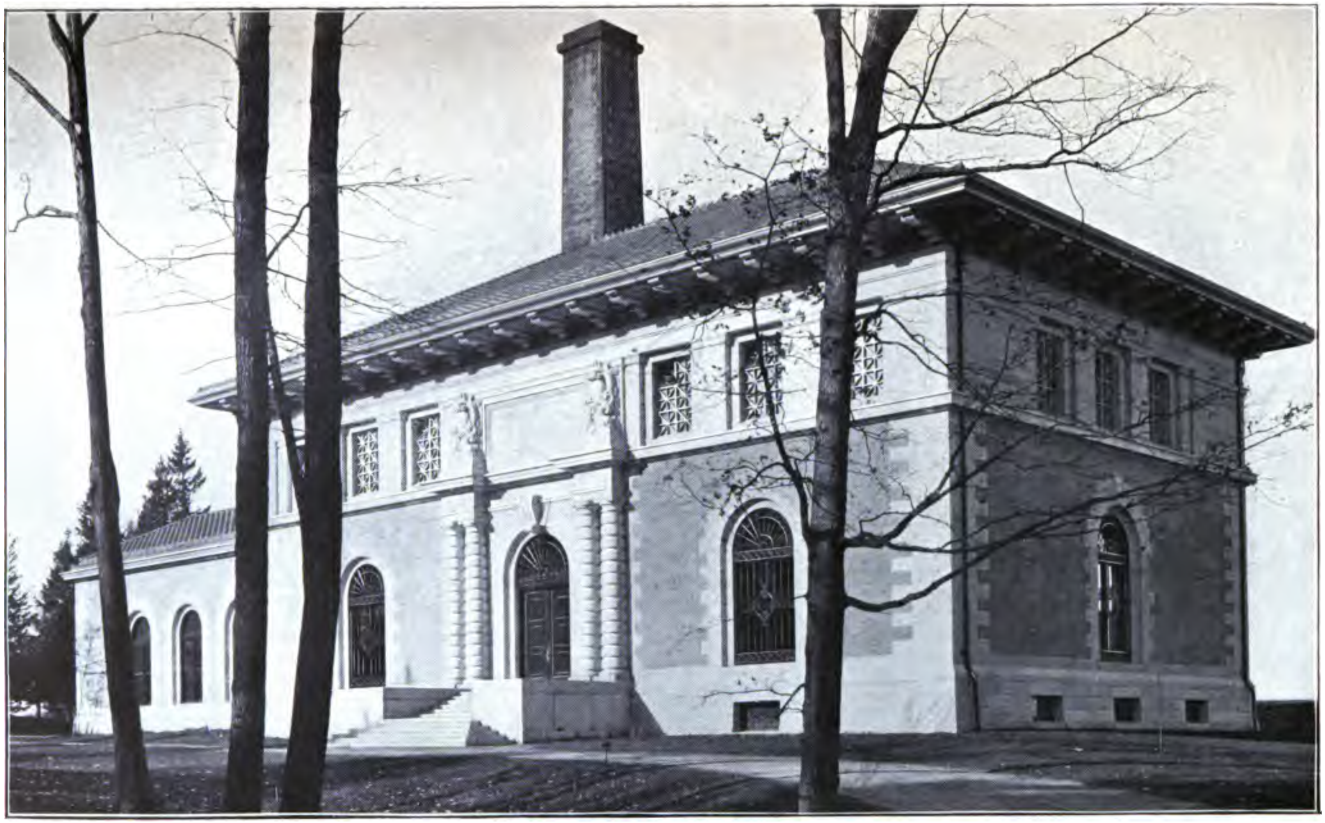
The building of the Chestnut Hill low-service pumping station has been entirely completed, with the exception of the slate floor in the engine and dynamo rooms. This building was erected, under the requirements of the engineers, from designs by Shepley, Rutan & Coolidge, architects, and the work of construction was performed by Norcross Brothers. The exterior is in general of Indiana limestone, with base of Milford pink granite. The entire length of the building is 223 feet 2½ inches, the width of the main portion 81½ feet, and its height 56½ feet. The height of the tower is 81 feet 3 inches.

The grounds about the building have been graded and planted with shrubbery.

The three pumping engines built for this station by the Holly Manufacturing Company have been completed, put in place and are in satisfactory operation. They each have a capacity for pumping 35,000,000 gallons per day.

The total amount paid, up to January 1, 1901, for the building, exclusive of engineering, has been $206,035.50; the amount paid for the engines, boilers and the appliances and equipments connected therewith has been $167,343.92.

The water for the low-service district of Boston is now, by means of these engines, entirely furnished by pumping, instead of by gravity, from the Chestnut Hill and Brookline reservoirs. This change was made in accordance with the original recommendations of the State Board of Health, and the increase in pressure, amounting to from 20 to 25 feet, was required on account of the greater height of many of the modern buildings erected in the city, the former pressure by gravity being hardly sufficient even for the lower



SPOT POND PUMPING STATION.

portions of the District. A somewhat greater pressure will be afforded in the future.

The new gate-house on the shore of the reservoir near the pumping stations has been substantially completed, and the necessary connections have been made.

(7) SPOT POND PUMPING STATION.

The pumping station at Spot Pond, which was in process of erection at the beginning of the year, has been substantially completed. This building was designed by Messrs. Shepley, Rutan & Coolidge, architects, and was constructed by McNeil Brothers, contractors.

The exterior walls are of gray brick with limestone trimmings, and have a base of Milford pink granite. The roof is covered with red tiles. Its entire length is 184 feet 10 inches, the width of the main portion 66 feet 10 inches, and its height 67 feet 9 inches. The cost of the building, including the engine and boiler foundations, has up to the present time amounted to $118,952.22.

The Leavitt engine, which was built by the city of Boston in the year 1895 for the Mystic pumping station, and having a daily capacity of 10,000,000 gallons, has been removed to this station; and a new Holly engine has been erected here, with a capacity for pumping 20,000,000 gallons per day. Both of these engines are now in satisfactory service. The cost of engines, boilers and appliances and equipments connected therewith has been $108,244.49.

A gate-house has been erected at the southern end of the pond, which is of gray brick with limestone trimmings, with roof of red tiles. The exterior dimensions of this building are 18 feet by 26 feet. Its cost was $4,400.

(8) ENLARGEMENT AND IMPROVEMENT OF SPOT POND.

The work of improving Spot Pond by the removal of the mud and the raising of the level of the pond was actively continued during the early part of the year, and has been finally completed. This body of water has been converted from a muddy, and, in many portions, shallow pond, into an excellent reservoir for the storage and distribution of water. The material in the bed of the pond has been removed so as to afford a minimum depth of 15 feet at high-water level, and its capacity has been increased from about 750,000,000 gallons to about 1,800,000,000 gallons. The soil removed has been deposited upon the shores and the neighboring grounds in such a manner as to remove any objectionable appearance in the dikes, whose construction was necessary in places as barriers, and otherwise to improve rather than disfigure the landscape. The shores have been given a natural and diversified appearance. The roads about the pond have not only been raised, but have also been considerably improved.

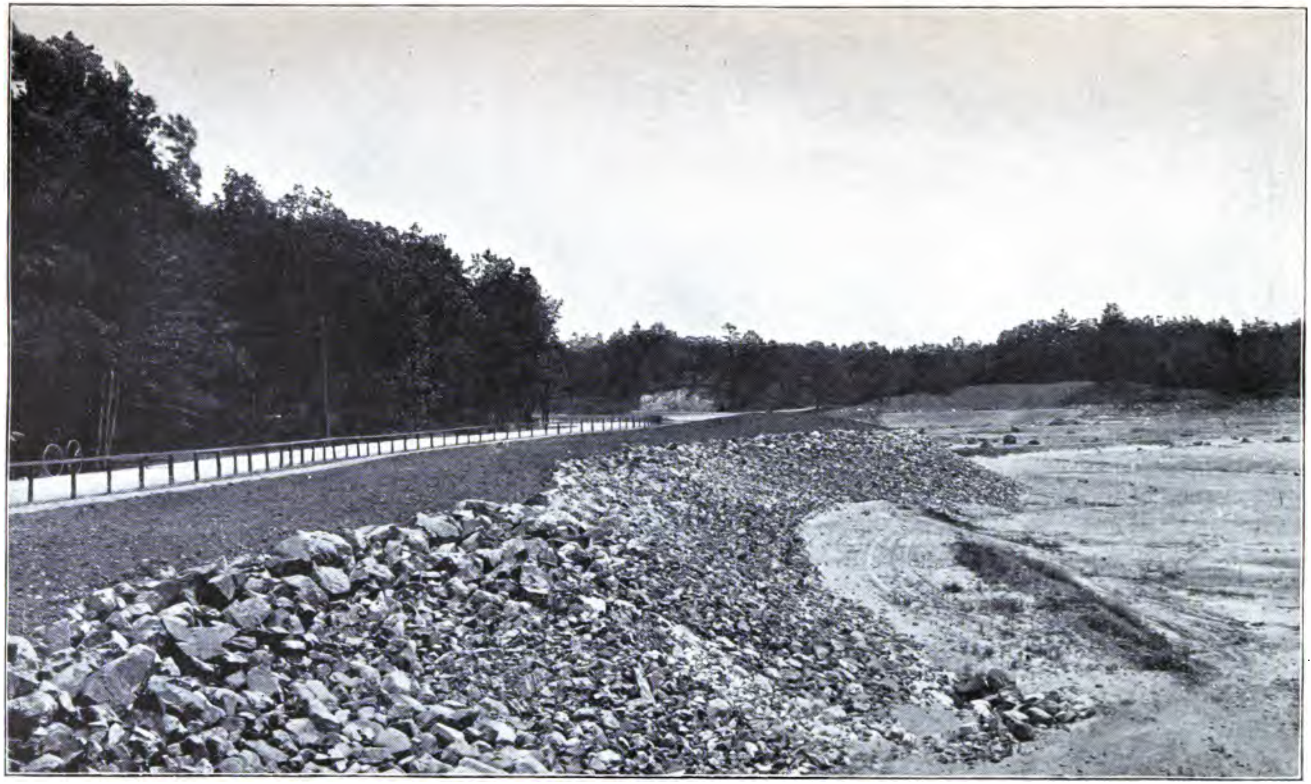
The raising of the water level has caused the flowing of lower adjoining lands, by which two smaller ponds of attractive appearance, and separated from Spot Pond only by a roadway, have been formed. These smaller ponds will not be connected directly with the water supply, and consequently will be open for use in the park for boating, fishing or skating.

The engineers in the treatment of this improvement have been assisted by Olmstead Brothers, landscape architects. Although Spot Pond has assumed a new aspect as a part of the Metropolitan Park System, the work has been so accomplished that it, as well as the smaller Fells Reservoir, will in the future become, if they have not already become, a desirable addition to the park system. At the same time, its capacity has been more than doubled. By its situation, 29 feet above the level of Chestnut Hill Reservoir, it has been made an efficient factor for the supply of many parts of the District, and affords great additional security in case of emergency or accident.

This work has been completed at a cost small in comparison with the improved results obtained.

The following table gives a summary of expenditures on account of work at Spot Pond: —

	For the Year ending December 31, 1900.	From Beginning of Work, and ending December 31, 1900.
Contracts for gate-houses, inlets, earthwork and drainage system, also core wall, . . .	$191,075 72	$396,322 68
Land settlements, ...	6,715 56	60,315 56
Engineering, ...	26,705 17	81,170 42
Preliminary and additional work and other expenses, including day labor, ...	15,459 02	87,203 12
Totals, ...	$239,955 47	$625,011 78



SPOT POND—PORTION OF THE SHORE AS IMPROVED.

(9) MAIN DISTRIBUTING PIPE LINES.

No long main pipe lines have been laid during the year, but considerable general work has been accomplished. Short lines of 60-inch and 48-inch pipes have been laid in the vicinity of the Chestnut Hill pumping stations. The rebuilding of the bridges over the Pines River, on Broadway, in the towns of Revere and Saugus, by the Massachusetts Highway Commission, made it necessary to relay several hundred feet of 16-inch pipe crossing the river at these bridges, and to reconstruct the boxes in which the pipes were enclosed.

The 20-inch pipe line which was originally laid by the city of Boston, in order to supply East Boston, across Chelsea Creek from a point in Chelsea to East Boston, had become so impaired that it seemed necessary that a new pipe line should be laid across the creek. Accordingly, an arrangement was made with the city of Boston by which the Board agreed to take the existing 20-inch and 24-inch pipe lines and to replace the old 20-inch line by a new 24-inch pipe line across Chelsea Creek, it being understood that the city should not claim further compensation on account of such taking. This new line has been completed, and by means of it and the old 24-inch line the water is now supplied, by connection with the great 42-inch Metropolitan main in Chelsea, directly into East Boston. The length of the line replaced was 1,438 feet.

The proposed widening and deepening of the draw opening in Mystic River at Chelsea Bridge, so called, between Chelsea and Charlestown, necessitated the laying of a new 24-inch pipe main in the line across the Mystic River. This line belonged to the city of Boston, and was not a part of the Metropolitan system. The Board, however, agreed with the city to undertake the work and to assume the charge and care of the line from its connection with the Metropolitan main in Chelsea to the Boston side of the draw, the city agreeing to continue to maintain the line to its connection with the Charlestown mains. In this way an additional means of supplying Boston proper and Charlestown from the Metropolitan main is ensured. On account of the greater depth and width of the draw opening, it was found necessary to substitute for the old siphon a tunnel 6 feet in diameter and 145 feet in length, in which the new 24-inch pipe line will be laid. This tunnel is built at a depth of 47 feet below the level of the water at low tide. The work is of considerable difficulty, but has so far been successfully carried on.

The following is a summary of the purposes of the expenditures for pipe lines and connections in the distribution system: —

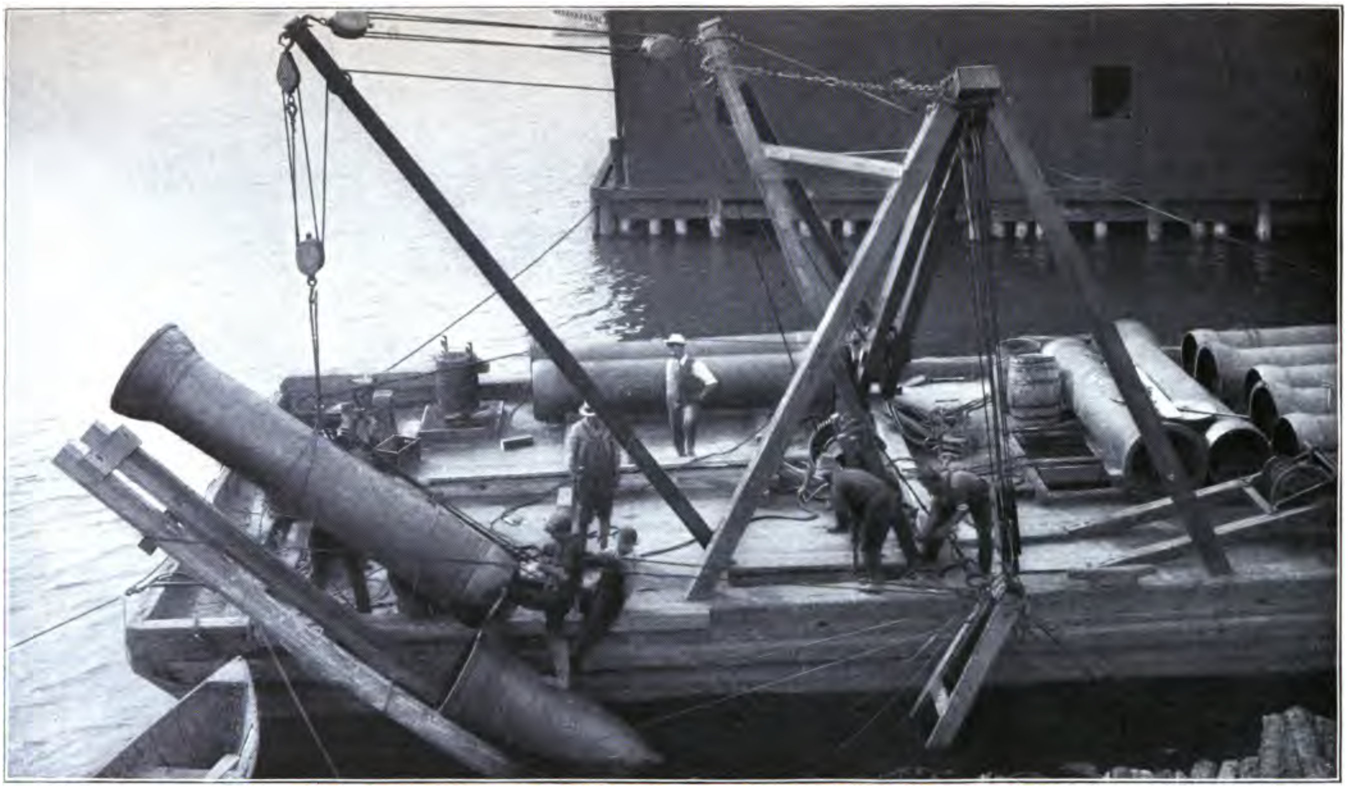
	For the Year ending December 31, 1900.	From Beginning of Work, and ending December 31, 1900.
Contracts for pipes, valves, pipe laying, etc.,	$21,288 59	
Less value of pipes, valves, etc., purchased and sent to store yards in previous years, but transferred to works, and included in cost of same for the current year,	16,240 87	
	$5,047 72	$1,987,314 82
Land settlements,	–	9,999 00
Engineering,	13,741 96	178,529 19
Preliminary and additional and other expenses,	32,404 04	183,550 84
Totals,	$51,193 72	$2,359,393 85

(10) FORBES HILL RESERVOIR AND STANDPIPE.

The construction of a reservoir and standpipe on Forbes Hill in the city of Quincy was begun in July of the present year, and the larger part of the work has been accomplished. The reservoir when completed will be 350 feet long and 170 feet wide, having a depth of 17 feet and a capacity for holding 5,000,000 gallons. A walk is to be built around the reservoir, which will, under certain proper restrictions, be open to the city of Quincy as a resort and point of observation. A steel standpipe in connection with the reservoir has been erected, 30 feet in diameter and 64 feet high. Pipes have been laid to connect the mains with the standpipe, and it was placed in service at the end of the year. During the coming season the standpipe will be enclosed by a masonry tower.

(11) PURCHASE OF WABAN HILL RESERVOIR IN NEWTON.

The Board has, during the past year, acquired from the city of Newton the Ward Street or Waban Hill Reservoir, so called, belonging to that city. It was deemed desirable to purchase this, for the



LAYING 24-INCH FLEXIBLE-JOINTED PIPE ACROSS CHELSEA CREEK.

better regulation of the pressure in the higher service in that portion of the District, and also to afford an additional reservoir in case of accident or emergency.

This reservoir was built by the city of Newton in the year 1877, but its immediate necessity to the water service of that city had been superseded by the building of another and higher reservoir. It is located 15 feet above the Fisher Hill Reservoir, and has a capacity of 13,500,000 gallons.

The reservoir was conveyed to the Commonwealth on October 12, 1900, and it was cleaned, repaired and refilled with water and put into active service on December 17. It was agreed that the city of Newton should be allowed to have its new reservoir continue to overflow into the Waban Hill Reservoir, as before; and that, until the city obtains a regular supply of water from the Metropolitan Water Works, water shall be furnished to the city free of charge in cases of emergency, unless the emergency arises from a deficiency in the capacity of its sources of supply, in which case the total quantity of water to be so furnished is not to exceed the contents of the reservoir. The land which was conveyed to the Commonwealth embraced the premises included within the surrounding streets. The amount paid was $60,000.

(12) Building of Weston Aqueduct and Reservoir.

Many surveys and investigations have been made during the year for the purpose of determining the most feasible route for the building of an additional aqueduct from the Sudbury Reservoir, the construction of which has become a pressing necessity. The general route of the Weston Aqueduct, so called, has been determined, the equalizing reservoir has been located, and measures have been so far advanced that plans and specifications will be made so that the actual work of construction can begin early in the coming year.

This aqueduct will extend from the dam at the Sudbury Reservoir in Southborough, through portions of Framingham, Wayland and Weston, to a point a little south of the central part of the town of Weston, where it is proposed to construct the equalizing reservoir. From the reservoir the aqueduct will extend a short distance further to the high land west of the Charles River, about ½ mile north of the Boston & Albany Railroad; and from the termination of the aqueduct main pipe lines will be built from time to time as the necessities of the District shall require. The aqueduct will have a capacity of carrying 300,000,000 gallons per day. The valley of the Sudbury River, north of Saxonville, in the town of Framingham, will be crossed by siphon pipes. There will be five tunnels, having a total length of nearly 12,000 feet, or considerably more than 2 miles. The entire length of the masonry aqueduct will be 13.4 miles. The end of the aqueduct in Weston will be 65 feet higher than the Chestnut Hill Reservoir and 36 feet higher than Spot Pond, so that the water can be conveyed by gravity from its termination to the District.

The equalizing reservoir to be built in Weston will have an area of about 65 acres. It is believed, from the estimates formerly made, that the cost of the aqueduct, the reservoir and the pipe lines first required will not exceed $5,000,000, and it is expected that its construction can be accomplished in three years.

(13) Purchases and Takings of Land.

The Board has gone on in the taking of lands required for the construction of the Wachusett Reservoir as fast as the necessary surveys have been completed and definite determinations have been reached in regard to the limits required. The takings naturally began at the lower part of the proposed basin in Clinton and have been carried along up the valley, and the takings already made embrace approximately 96 per cent. of the entire area which is to be acquired.

In the making of takings, wherever land has been required for the purposes of the works, it has been the policy of the Board to include the lands, the deeds of which it had already received, so that by far the larger part of the territory embraced in the various takings had been previously acquired by purchase.

Much progress has been made during the year, not only in the purchase of lands not previously acquired, but also in the settlement for lands taken of which no purchase had been previously made.

Settlements under such purchases and takings, both in the Wachusett basin and elsewhere, have been effected in 86 cases, and for an aggregate of 1,267.80 acres, with the buildings thereon, and the water and other rights connected therewith. The sums paid in these settlements have amounted to $235,725.50. In only 2 of these cases have the settlements been the result of suits at law, and the amount paid in these suits has been $6,946.79.

Since the beginning of its operations the number of settlements effected by the Board has amounted to 590, and under them the Board has acquired 10,380.13 acres, or 16.22 square miles. An aggregate of $3,304,418.20 has been paid for the lands acquired and the buildings and water and other rights connected therewith, but not including payments for diversion of water and depreciation in value and other damages not connected with lands acquired.

Of the entire 590 cases of settlements effected, under which the damages paid have amounted to $3,304,418.20, only 6 cases have been settled by suits at law, and the amount paid under the judgments of court has been $21,437.47.

The following table shows the purposes for which the lands have been acquired and the location of the lands for which settlements have been made, the number of acres settled for and the amounts paid, both for the year 1900 and for the entire period since the beginning of the work: —

Summary of Land Settlements to December 31, 1900.

LOCATION.	For the Year 1900.			From Beginning of Work.		
	Area in Acres.	Number of Settlements.	Payments.	Area in Acres.	Number of Settlements.	Payments.
*Wachusett Reservoir.**						
Clinton, . . .	63.09	51	$180,705 34	1,158.16	303	$2,418,847 07
Boylston, . . .	753.42			3,491.24		
West Boylston, . .	140.98			1,319.10		
Sterling, . . .	29.47			561.48		
Lancaster, . . .	-			69.97		
Holden, . . .	-			167.00		
Total, . . .	986.96	51	$180,705 34	6,766.95	303	$2,418,847 07
Wachusett Aqueduct.						
Berlin, . . .	4.07	7	$8,271 00	46.51	60	$68,712 40
Boylston, . . .	.38			.38		
Northborough, . .	-			82.56		
Southborough, . .	29.20			76.36		
Marlborough, . .	6.90			50.62		
Clinton, . . .	-			13.51		
Total, . . .	40.55	7	$8,271 00	269.94	60	$68,712 40
Sudbury Reservoir.†						
Southborough, . .	4.49	3	$1,349 00	1,995.58	150	$658,318 75
Marlborough, . .	4.86			750.98		
Total, . . .	9.35	3	$1,349 00	2,746.56	150	$658,318 75

* Including payments on account of St. John's Catholic Cemetery.

† Including settlements made by city of Boston.

Summary of Land Settlements to December 31, 1900 — Concluded.

LOCATION.	FOR THE YEAR 1900.			FROM BEGINNING OF WORK.		
	Area in Acres.	Number of Settlements.	Payments.	Area in Acres.	Number of Settlements.	Payments.
Improvement Sudbury Watershed.						
Northborough, . .	10.71	4	$1,269 60	114.52	28	$10,941 10
Southborough, . .	-			2.66		
Westborough, . .	14.24			201.48		
Ashland, . . .	.63			.63		
Marlborough, . .	.74			.74		
Total, . . .	26.32	4	$1,269 60	320.03	28	$10,941 10
Clinton Sewerage System.						
Clinton, . . .	2.81	12	$9,761 50	4.01	20	$17,961 50
Lancaster, . . .	37.58			81.21		
Total, . . .	40.39	12	$9,761 50	85.22	20	$17,961 50
Weston Aqueduct.						
Weston, . . .	143.36	7	$27,653 50	143.36	7	$27,653 50
Framingham, . .	18.00			18.00		
Total, . . .	161.36	7	$27,653 50	161.36	7	$27,653 50
Distribution System.						
Boston, . . .	-	2	$6,715 56	.70	22	$101,983 88
Brookline, . . .	-			.05		
Arlington, . . .	-			1.80		
Malden, . . .	-			.16		
Medford, . . .	-			2.39		
Newton, . . .	-			.06		
Quincy, . . .	-			5.23		
Stoneham, . . .	2.87			19.68		
Total, . . .	2.87	2	$6,715 56	30.07	22	$101,983 88
Aggregates, . .	1,267.80	86	$235,725 50	10,380.13	590	$3,304,418 20

The takings of real estate during the year have numbered 14, and have embraced an area of 3,472.697 acres. Nearly all of the land taken was for the Wachusett Reservoir, but small takings were made on account of the Medford pipe line and the Chelsea pipe line, for the Clinton sewerage system, and for the improvement of Spot Pond. The fee was taken in 3,466.438 acres, and easements only in 6.259 acres.

The purposes and location of the various takings made during the past year, the nature of the takings and the number in which settlements have been made, are shown by the following table: —

TOWN.	Fee.	Easement.	Settled.
Wachusett Reservoir.	Acres.	Acres.	Acres.
Boylston,	2,119.140	-	1,702.620
West Boylston,	1,339.521	-	1,128.706
	3,458.661	-	2,831.326
Distribution.			
Boston,	-	1.270	-
Chelsea,	.508	4.790	-
Medford,	-	.199	.121
Stoneham,	.160	-	-
	.668	6.259	.121
Clinton Sewerage.			
Lancaster,	7.109	-	2.379
Aggregates,	3,466.438	6.259	2,833.826

Land not previously purchased has been taken from 60 different owners, with 13 of whom settlements have been effected. Of all the land taken by the Board for the Metropolitan Water Works since the beginning of its operations (aside from the takings made of the water works of the cities of Boston, Malden, Medford and Melrose), embracing 8,093.789 acres, settlements have been effected with the owners of all but 909.62 acres.

The following is a list of all takings made in the year 1900: —

List of Takings from January 1, 1900, to January 1, 1901.

No.	LOCATION AND DESCRIPTION.	Former Owners.	Recorded.	Purpose of Taking.
			1900.	
56	Boylston and West Boylston (both sides of Boston & Maine Railroad, between roads from Sawyer's Mills to Boylston Centre, from Clinton to West Boylston, and the Scar Bridge Road). Area, 863.16 acres in fee.	John F. O'Brien *et al.*	Mar. 15.	Wachusett Reservoir.
57	Boylston and West Boylston (both sides of Boston & Maine Railroad and Nashua River, between Lancaster Street and Dover Road, Beaman Street and Clinton and Boylston Centre County Road). Area, 959.90 acres in fee.	Helen C. Harlow *et al.*	Mar. 28.	Wachusett Reservoir.
58	Boylston and West Boylston (south of Boston & Maine Railroad, southwesterly of road from Boylston Centre over Scar Bridge to West Boylston, and both sides of Dover Road). Area, 755.53 acres in fee.	Wm. R. Albertson *et al.*	Mar. 29.	Wachusett Reservoir.
59	Boylston and West Boylston (on Dover and Sand Hill roads, Temple and Pierce streets, and new highway). Area, 39.53 acres in fee.	Levi L. Flagg *et al.*	Mar. 31.	Wachusett Reservoir.

List of Takings from January 1, 1900, to January 1, 1901 — Concluded.

No.	LOCATION AND DESCRIPTION.	Former Owners.	Recorded.	Purpose of Taking.
60	Boston and Chelsea (on Chelsea Creek and rights in Chelsea North Bridge, Broadway, Williams Street, Marginal Street, etc.). Area, 0.508 acre in fee, easements in 6.06 acres.	City of Boston.	**1900.** May 11.	Pipe line.
61	Stoneham (Hurd Avenue). Area, 0.160 acre in fee.	Samuel G. Pool *et al.*	June 26.	Spot Pond improvement.
62	Boylston (both sides of the River Road). Area, 231.76 acres in fee.	Levi L. Flagg *et al.*	July 25.	Wachusett Reservoir.
63	West Boylston (between Central Massachusetts Railroad and Worcester, Nashua & Portland Railroad, and on southeasterly side of Prospect and Worcester streets). Area, 113.30 acres in fee.	American Telephone and Telegraph Company *et al.*	July 25.	Wachusett Reservoir.
64	West Boylston (between Central Massachusetts Railroad and Worcester, Nashua & Portland Railroad, and between Worcester Street and the Nashua River). Area, 51.171 acres in fee.	Cyrus Colt *et al.*	Aug. 1.	Wachusett Reservoir.
65	Lancaster (on High and Mill streets). Area, 7.109 acres in fee.	Wm. O. Johnson *et al.*	Aug. 4.	Clinton Sewerage System.
66	West Boylston (northeasterly of Central Massachusetts Railroad, both sides of Main Street, including Beaman, Fletcher, Union, Howe, and Cross streets). Area, 64.83 acres in fee.	Helen C. Harlow *et al.*	Aug. 17.	Wachusett Reservoir.
67	West Boylston (southwesterly of North Main Street and southerly of Holden Street). Area, 325.67 acres in fee	George H. Holmes *et al.*	Sept. 1.	Wachusett Reservoir.
68	Medford (20 feet strip extending from High Street across Mystic River to South Street Court). Area, easements in 0.199 acre.	Charles F. O. Henderson *et al.*	Nov. 15.	Pipe line.
69	West Boylston (both sides of Central Massachusetts Railroad and of Holden Street). Area, 53.81 acres in fee.	L. M. Harris Manufacturing Company *et al.*	Dec. 14.	Wachusett Reservoir.

(14) Claims for Damages to Business.

Claims for injury to business by the carrying out of the Metropolitan Water Act, through loss of custom or otherwise, may, under the Act and by subsequent statutes, be brought by any individual or firm owning an established business on April 1, 1895, on land in the towns of West Boylston, Boylston, and in that portion of the town of Sterling situated near the proposed work.

During the year, 76 such claims have been filed, making the total number filed up to December 31, 1900, 296. Settlement has been effected in 79 cases during the year, under which the sum of $13,510 has been paid, making a total of 159 claims which have been settled, for which a total sum of $41,930 has been paid to the several claimants. Claims to the number of 7 have been disallowed during the year. The remainder of the claims of this class have been investigated, and offers have been made in 63 cases in which no agreement has yet been reached.

(15) Claims for Loss of Employment.

Damages for loss of employment are given to residents of the town of West Boylston, who are obliged, on account of the stopping of their work by reason of the operations of the Board in the Wachusett Reservoir, to seek employment elsewhere.

Claims for such damages to the number of 222 have been filed with the Board during the year. Settlements have been effected in 190 cases, and 21 claims have been disallowed. Offers have been made in 3 cases on which no agreement has been reached. The amount paid in settlement of such claims during the year has been $34,819.23. Claims of this class to the number of 314 have been filed up to December 31, 1900, under which a total sum of $47,732.91 has been paid.

(16) Claims for Depreciation of Real Estate.

The settlement of claims for injury to real estate not taken, but directly or indirectly decreased in value by the Metropolitan Water Act, or the operations of the Board thereunder, has received much attention during the year. The territory for which these damages are payable comprises the whole of the town of West Boylston, the portion of the town of Boylston north of the proposed Wachusett Reservoir, a portion of the town of Clinton below the Wachusett Dam, and that section of the town of Sterling south and west of Stillwater River.

Many matters which tend to affect the value of lands in the territory named are still so uncertain or undetermined as to make the amount of damages a difficult question to determine. The location of roads, and especially the relocation of the Central Massachusetts Railroad, will have considerable influence upon various sections; and at best it is no easy matter to judge what in the future will be the result of the operations of the Board to the various sections of this territory. The Act provides that the Board may, upon the application of the owner of any real estate so injured, agree with him upon the damages to be paid, or, if they cannot agree, the owner may file a petition for the determination of such damages. Such application for damages has been made by 160 owners of real estate. Offers for settlement have been made upon all such applications filed by owners of real estate in West Boylston prior to December 31, 1900. Settlements have been effected during the year in 32 cases, under which the sum of $19,960 has been paid to claimants.

During the preceding year 9 cases were settled, involving a payment of $2,775.

These cases do not include, however, many cases in which damages for depreciation of lands were included in a settlement of damages for other real estate taken.

(17) City of Boston Settlement.

The Board, in accordance with the provisions of the Metropolitan Water Act, on the first day of January, 1898, made a taking, for the purposes of the water works, of the Chestnut Hill Reservoir and pumping station, and of all the lands, reservoirs, dams, aqueducts, pumps and other property held by the city of Boston, westward of Chestnut Hill Reservoir, for the purposes of storing and supplying water for the water supply of the city, including Lake Cochituate and the Cochituate Aqueduct, the Sudbury basins and the Sudbury Aqueduct, and the Mystic Lake, aqueduct, pumping station and reservoir.

The Board had previously, in the year 1896, taken the Sudbury Reservoir, which was in process of construction by the city of Boston, and had assumed the contracts which had then been entered into by the city. In accordance with the requirements of the Act, that the city of Boston should be reimbursed for all money paid for land damages, or otherwise, in connection with the building of this reservoir, the Board had paid to the city of Boston, in reimbursement for the sums paid out by the city for these purposes, the sum of $1,154,776.84.

Some negotiations had been had for the adjustment of the amount due the city for the taking of its works other than those for which direct reimbursement was required, and the sum of $5,000,000 had been paid by the Board and received by the city on account. The limit of the time for bringing a suit, however, being about to expire, the city in the latter part of the year 1899 filed a petition in court for the determination of its damages by reason of the taking of its works. Under this suit an agreement was entered into by the Attorney-General of the Commonwealth and the City Solicitor of the city of Boston, in accordance with which judgment was entered on November 1, 1900; and the entire damages on account of the taking of January 1, 1898, were fixed at $12,531,000, requiring payment to the city of Boston of the sum of $7,531,000, in addition to the amount already paid to the city on account. The judgment provided that the damages should be assessed as of November 1, 1900, and that the said sum of $7,531,000 should bear interest after that date at the rate of 3½ per cent. per annum.

(18) Taking of Spot Pond from the Cities of Malden, Medford and Melrose.

On January 1, 1898, a taking was likewise made, under the Act, of Spot Pond and the adjoining lands, together with the Melrose pumping stations, and one of the Medford and one of the Malden pumping stations. These lands were taken from the cities of Malden, Medford and Melrose, which had exercised a joint ownership over the larger part of them, and had acquired Spot Pond in common for the purposes of their water supplies. Some negotiation has been had with these cities for the purpose of effecting a settlement, and the sum of $25,000 has been paid to the city of Malden on account.

(19) Claims for Damages by Owners on Spot Pond Brook.

Various claims have been made for damages by owners of lands abutting on Spot Pond Brook, which flows from Spot Pond down through portions of Stoneham and Melrose, into Malden and the Mystic River. These parties claim that the letting down of the water from Spot Pond at times and in quantities different from the natural flow of the brook has caused injury to the lands and buildings by an unusual overflow. Three suits came to trial, and damages to the amount of $109.56, $27.39 and $100.79 respectively, besides interest and costs, were recovered.

(20) NASHUA SEWERAGE.

The city of Nashua at a very early period presented a large claim against the Commonwealth for damages on account of injuries which would result to that city from the taking of the waters of the South Branch of the Nashua River. The city contended that the diversion of this water would largely lessen the power of the river to carry away the sewage of the city, as the sewage works were then constructed; would greatly aggravate the troubles from existing offensive deposits in the river; would, in fact, compel the city to put in an entire new system of sewerage for the purposes of carrying the sewage to the Merrimack River; and that many other injuries would result to the city consequent upon the diversion and the taking of the Nashua waters.

The questions at issue were largely investigated by engineers upon both sides, and several plans were made and considered as to the best methods which could be adopted to relieve any difficulties which might result. Some constitutional questions were also involved in the claim made by the city. The negotiations were finally brought to a close in February of the present year, and a settlement was effected with the city, in which the Attorney-General concurred, by which $33,000 was paid, and a release was given by the city of all claims arising by reason of the taking and diversion of the waters of the South Branch of the Nashua River.

III. WORK OF MAINTENANCE.

(1) OPERATION OF WORKS.

In addition to the duties of construction, there have devolved upon the Board the maintenance and operation of the new works which have been constructed and of the old works which have been taken for its purposes, and the furnishing of a water supply to the cities and towns of the Metropolitan Water District.

Eight cities and seven towns, having a population of 814,103, were with slight exceptions furnished with their entire water supply, receiving on an average 94,205,000 gallons per day. The city of Newton and the town of Hyde Park, although parts of the District, obtain their supply from local sources.

It was found possible early in the year to dispense altogether with the small local pumping stations, and now the Metropolitan pumping works are alone in use. The entire amount of water, about 31,000,000 gallons per day, supplied the high services was necessarily pumped to a considerable elevation. Pumping has been required also for the supply of a large portion of the low-service districts, and now, by arrangements recently effected, the remainder of the water supplied is also pumped, in order to gain a greater pressure than can be afforded by gravity.

The work of maintenance requires not only the operation of the pumping stations, but includes the supervision and care of the various reservoirs, filter-beds, aqueducts and main pipe lines, which extend throughout the District, together with the pipe yards, repair works, and buildings and grounds necessary for the various purposes. This work has called for the regular employment of a force averaging 145 men, and the expenditure of $299,143.49.

(2) Mystic Lake and Pumping Station.

The waters of Mystic Lake have not been used for purposes of water supply since they were taken from the city of Boston on January 1, 1898, the water being much inferior in quality for domestic uses to the other waters of the Metropolitan system. The works have been kept in good condition, so that they can be put into operation, if called for in the future, or perhaps can be put into service in the future to supply water for other than domestic uses. In the mean time, permission has been given to parties in Medford and Winchester to use the lake for boating purposes.

An agreement, terminable by either party at short notice, has been entered into between the Metropolitan Water Board and the Metropolitan Park Commission, providing that the Park Commission shall furnish such police protection to the lands and waters in and near the Upper Mystic Lake and the Aberjona River as may be necessary for the preservation of order, the prevention or regulation of boating, bathing and fishing, and the enforcement of such regulations as may be made by the joint action of the Board and Park Commission; and shall exercise such care and control in and upon said lands and waters in common with the Board as may be required for the purpose.

The Mystic Reservoir on College Hill, Medford, with its connections, is utilized as an equalizing and distributing reservoir.

(3) SANITARY INSPECTION AND REGULATIONS.

The watersheds of the various sources of supply have been constantly inspected by the sanitary inspector and his assistant, in order to insure suitable sanitary conditions, and to prevent contamination of the water from infectious diseases. The larger part of the work has been directed to the Sudbury and Cochituate watersheds, but considerable attention has been devoted by the inspector to the Wachusett watershed, partly in assisting the medical inspector whose attention has been devoted to the works of construction.

The number of different premises inspected on the Sudbury and Cochituate watersheds has been 1,041. Many cases of objectionable drainage have been prevented, offensive cesspools have been abandoned, the building of sewer connections or cesspools has been required, manufacturing wastes have been diverted from the supply, and in other ways sources of contamination have been removed, so that a marked improvement has been effected in the sanitary condition of the watersheds.

Under the rules made by the State Board of Health during the preceding year for the sanitary protection of the waters used for the Metropolitan water supply, special regulations have been made permitting the cutting and taking of ice from the open channel of the Wachusett Aqueduct and from the Sudbury Reservoir in the town of Southborough, and providing that the work should be so carried on that little or no pollution would be caused to the water supply. Somewhat different regulations were made for the Sudbury Reservoir from those made for the open channel, inasmuch as certain privileges were reserved to the town of Southborough under the agreement made by that town with the city of Boston. Copies of the regulations adopted will be found in an Appendix.

Endeavor has been made to enforce the statutes of the Commonwealth and the regulations of the State Board of Health prohibiting bathing in all waters which are used for the purposes of domestic water supply.

The Board has not deemed it necessary to take measures for the prevention of skating upon several of the reservoirs, desiring to permit such use by the public of the various reservoirs and ponds as would be consistent with the proper protection of the purity of the waters.

(4) The Year's Water Supply.

The year 1900 was a peculiar one as respects the water supply. Owing to the drought of the previous year, the amount of water stored at the beginning of the year was unusually small, 6,428,400,000 gallons being in storage in the various reservoirs, out of a total capacity of 15,856,500,000 gallons. The rainfall in February and March was almost unprecedented. The ground at the time of the heaviest rains was frozen, and in such condition that the water, without saturating the soil, flowed directly into the streams, causing serious freshets and quickly filling the reservoirs, while large quantities of water overflowed into the rivers. On the other hand, the rainfall during the summer was exceptionally small, so small that for two consecutive months the flow of the streams of the Sudbury system was considerably less than the evaporation from the reservoirs. At the same time the dry weather caused a greatly increased consumption, and, as a result, the reservoirs were unusually drawn down and the quantity of water in storage was in November seriously reduced. During the five months from June to October, inclusive, the combined yield of the Wachusett and Sudbury watersheds was less than in any previous year included in the records. The drought seemed ended by the November rains.

As large a quantity of water as possible was drawn from the Nashua River, on account of its superior quality, and this constituted the chief supply. Water was, however, drawn from Lake Cochituate during about seven months. Considerable quantities, also, had to be drawn, chiefly during the latter part of the year, from Framingham Reservoir No. 2 and the Ashland and Hopkinton reservoirs, and a small quantity was drawn from the Whitehall Reservoir.

There was an average daily flow from the Nashua River, through the Wachusett Aqueduct, of 60,452,000 gallons. The average daily flow through the Sudbury Aqueduct, which included both the Wachusett and Sudbury supplies, was 85,867,000 gallons. The average daily flow through the Cochituate Aqueduct was 12,236,000 gallons.

(5) Consumption of Water.

The Board has deemed it its duty to call the attention of the municipalities included within the District to the great increase from year to year in the use of water. The consumption of water in the cities and towns now composing the Metropolitan Water District has risen from 73.3 gallons daily per person in 1890 to 112.8 gallons daily per person in the year 1900, — an increase in the ten years of 54 per cent. The average daily consumption during the year 1900 in the cities and towns of the Metropolitan Water District actually supplied, being all, with the exception of Newton and Hyde Park, was 94,205,000 gallons, — a daily consumption per person of 115.5 gallons. The increase in the daily average consumption of water over the consumption of the previous year was 6.4 per cent., — an increase of 5.5 gallons per person within the year.

This increase in consumption is not only accompanied by a great increase in the expenditures for pumping and other current operating expenses, but it hastens the time when great expenditures must be incurred not only for new sources of supply, but also for new pumping facilities, new aqueducts and new mains. The average consumption now much exceeds that estimated for the future by the State Board of Health in the year 1895. This larger consumption has compelled the building of the new Weston Aqueduct prior to the time to which it might otherwise have been postponed. The representatives of the various municipalities in the District have been urged to the adoption of stricter regulations relative to abuses which arise from the improper use of hose and other appliances and from defective fixtures, and to a more rigid enforcement of existing regulations.

Under the Metropolitan Water Act as it now exists, the amounts of assessments laid upon the various cities and towns in the District are dependent upon valuation and population, and are not in proportion to the consumption of water in the cities and towns respectively. How economy in the use of water may be most effectively and reasonably encouraged is a somewhat difficult question. In order that any plan shall be wholly effective to accomplish the result, it may be necessary to provide that not only each city and town, but also that each individual water taker, shall have a direct financial interest in preventing waste and excessive use of water. It has been suggested that legislation should be called for by which the assessments of each city and town shall be made in proportion to the amount of water consumed; and, for further protection, that the use of meters should be wholly or in part compelled, or that municipalities or water takers should be encouraged in the use of meters by the promise of financial advantage.

The subject of the excessive use and waste of water will call in the immediate future for careful and extended investigation by the Board, and should receive the earnest attention of all the municipalities of the District.

The following is a summary of the expenditures for maintenance and operation: —

	For the Year ending December 31, 1900.
Temporary dam and gate-house at site of the Wachusett Dam, the Wachusett Aqueduct from Clinton to Southborough, and the pumping station, filter-beds, etc., of the Clinton sewerage system,	$16,919 49
The Sudbury, Ashland, Hopkinton, Framingham, Lake Cochituate and other reservoirs, the Sudbury and Cochituate aqueducts, the Pegan filters, the biological laboratory and other work in the Sudbury system, ...	81,656 81
Pumping at Chestnut Hill, Chelsea, Somerville, Spot Pond, West Roxbury and elsewhere, care of reservoirs and pipe lines, relaying pipes across Chelsea Creek, tunnel under Mystic River, and other work in the distribution system, ...	180,223 28
Administration, supervision, taxes and other general expenses, .	20,343 91
Total,.	$299,143 49

IV. ADMISSION OF OTHER MUNICIPALITIES INTO THE DISTRICT.

Considerable negotiation has taken place in regard to the admission of Stoneham into the Metropolitan Water District. It was found that it would be necessary, in order to supply a pressure equal to that which has been had in the town, to build a reservoir with a capacity of about 2,000,000 gallons on Bear Hill in the Middlesex Fells, and there would be required also considerable lines of main pipes in order to make connection with the pumping station and with the mains of the town. Early in the year the Board fixed the sum of $40,000 as the amount to be paid by the town on admission. Later, however, in the year, owing to the great decrease in the prices of materials, and one or two other favorable circumstances which had occurred, the Board assented to a reduction in the sum to be paid to $30,000. In accordance with this proposal, the selectmen, having been authorized by the vote of the town, made formal application for admission to the District on November 2. It is understood that, on account of delay in effecting a settlement with the water company owning the distributing water pipes in the town, the sum required has not been paid to the Commonwealth, and consequently the formal admission has not been accomplished.

In reply to inquiries made by the authorities of the town of Lexington, terms have been submitted under which that town would be admitted into the District, but no action has been taken by the town.

Negotiations and conferences have been had with the officials of other municipalities, but nothing definite has been accomplished toward their admission.

V. FINANCIAL STATEMENT.

(1) Receipts from Water Loans and Other Sources.

The total receipts from loans and other sources, on account of the Metropolitan Water Act, to December 31, 1900, amount, exclusive of premiums, to $21,138,386.37. These receipts, together with the fund available on January 1, 1901, are as follows: —

From sale of bonds,	$21,000,000 00
From the town of Nahant, on admission to the District,	20,000 00
From the town of Arlington, on admission to the District,	15,000 00
From the town of Swampscott, on account of supplying water,	22,645 84
From sale of water to water companies,	5,371 58
From rents, real estate and miscellaneous sources,	75,368 95
	$21,138,386 37
Distributed back to cities and towns in District, as provided in section 3 of the Metropolitan Water Act,	63,022 42
	$21,075,363 95
Amount approved for payment by Board to December 31, 1900,	20,693,870 47
Balance January 1, 1901,	$381,493 48

If to this balance is added the sum of $41,885.01 for bills, pay rolls, etc., sent to the Auditor in December, but not placed by him on warrants for payment until January, 1901, and the further sum of $6.75 on warrants of the year 1896, which has never been called for, and from this amount is subtracted the sum of $6,000, advanced by the Treasurer in December for use on the pay rolls of the Metropolitan Water Board, but not appearing in their accounts until January, 1901, and the further sum of $78.24, credited to the sinking fund instead of the loan fund, the result will be $417,307, which is the balance reported available in the treasury on January 1, 1901.

The Treasurer of the Commonwealth, under the authority of the Metropolitan Water Act to issue from time to time, on the request of the Board, negotiable bonds, to be designated the "Metropolitan Water Loan," to an amount not exceeding $27,000,000, has sold bonds as follows: —

DATE.	Bonds sold.	Rate (Per Cent).	Time (Years).	Price.	Premiums.
1895, . . .	$2,225,000	3½	40	$110 67	$237,407 50
1896, . . .	2,775,000	3½	40	110 67	296,092 50
1896, . . .	2,000,000	3½	39	106 76268	135,253 60*
1897, . . .	6,000,000	3½	38½	107 82	469,200 00
1898, . . .	2,000,000	3½	40	113 176	263,520 00
1898, . . .	2,000,000	3½	40	112 877	257,540 00
1899, . . .	3,000,000	3	40	100 64	19,200 00
1900, . . .	1,000,000	3	39	102 78	27,800 00
	$21,000,000				$1,706,013 60

* Including $18,673.60 from readjustment of rate made by Treasurer in 1897.

The Treasurer of the Commonwealth was required to establish a sinking fund sufficient, with its accumulations, to extinguish the bonded debt at maturity. To this sinking fund there is required to be paid the premiums from the sales of the bonds and the proceeds from the operations of the Board, exclusive of those arising from sales of property, and such further amounts, if any, as the Treasurer may deem necessary for the payment of the debt at maturity.

The sinking fund so established amounted at the end of each year to sums as follows: —

December 31, 1895,	$226,286 05
December 31, 1896,	699,860 70
December 31, 1897,	954,469 00
December 31, 1898,	1,416,374 29
December 31, 1899,	1,349,332 97
December 31, 1900,	1,573,619 72

For the payment of the interest on the bonds issued by the Commonwealth, the sinking fund requirements and the expenses of maintenance and operation of the water works, annual assessments are made upon the various cities and towns constituting the Metropolitan Water District. There is apportioned each year to the city of Boston such proportion of the required amount as the valuation of that city of the preceding year bears to the total valuation of all the cities and towns in the District; except that there is included in the amount of such valuations only one-sixth of the total valuation of any city and town which has not reached the safe capacity of its sources of supply in a dry year, as determined by the Water Board, and has not made application to the Board for water. The remainder to be raised is assessed to the other cities and towns in the District, one-third in proportion to their respective valuations and two-thirds in proportion to their respective populations, including, however, only one-sixth of the total valuation and one-sixth of the total population of any city or town which has not reached the safe capacity of its sources of supply, or has not made application for water as aforesaid. A city or town, on the other hand, which is assessed on its full valuation and population, and which furnishes a part of its water supply from its own works, or receives a supply from a water company, is allowed and credited in its apportionment with a sum equal to $12 for each million gallons of water so furnished, as determined by the Board. It was, however, provided by the Act that no such amount should be apportioned until the year 1898; and in that year that the amount of $300,000 only, together with such sums as had been expended by the State Board of Health in its investigations of a water supply for the Metropolitan Water District, should be assessed. In each succeeding year the said amount of $300,000, and $200,000 additional for each year thereafter, shall be so apportioned until the entire amount required for the payment of interest, sinking fund requirements and expenses of maintenance and operation is reached, and thereafter such entire sum so required is to be so apportioned.

The total sum, therefore, assessable in the year 1900 was $700,000, subject to the credits allowed the cities and towns furnishing water from their own sources. The total amount allowed the cities and towns so furnishing water, at the rate of $12 per million gallons, furnished from June 1, 1899, to May 31, 1900, was divided among the cities and towns as follows: —

Arlington,	$909 96*
Malden,	14 76
Medford,	488 64
Nahant,	107 76
Revere,	297 84
Winthrop,	213 00
Total,	$2,031 96

After deducting the above allowances, the net sums assessed, in accordance with the provisions of the Act, by the Treasurer of the Commonwealth upon the various cities and towns of the District, for the year 1900, were as follows: —

Boston,	$578,696 96
Chelsea,	15,897 53
Everett,	10,140 23
Malden,	15,892 01
Medford,	8,388 70
Melrose,	6,740 49
Newton,	3,393 02
Quincy,	11,271 59
Somerville,	28,689 24
Arlington,	3,104 87
Belmont,	1,966 14
Hyde Park,	1,044 44
Nahant,	1,053 04
Revere,	4,342 41
Watertown,	4,802 46
Winthrop,	2,544 91
Total,	$697,968 04

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* Corrected to compensate for excess allowed in 1899.

The smaller sums assessed upon the city of Newton and the town of Hyde Park were owing to the fact that neither of these municipalities had reached the safe capacity of its sources, and consequently neither had made application for water.

Under the provision of the Metropolitan Water Act, that any city or town not originally included in the District, any part of which is within ten miles of the State House, should be admitted into the District, upon such payment of money as the Board should determine; that the Board should, on application, furnish water to any water company owning the water pipe system in any city or town within said ten miles, upon its assuming the assessments of such city or town and making such payment of money as the Board should determine; and that the Board might furnish water to any other city or town or water company on a like payment of money, — sums have been received as follows: —

Quincy, for admission to District,	$5 00
Nahant, for admission to District,	20,000 00
Arlington, for admission to District,	15,000 00
Swampscott, for water furnished,	22,645 84
Revere Water Company, for water furnished,	4,839 70
Framingham Water Company, for water furnished,	531 88
Total,	$63,022 42

Of this amount the sum of $2,291.20 was received during the year 1900, and at the close of the year the Treasurer, in accordance with the requirements of the Act that sums so received should be distributed to the cities and towns of the District in proportion to the annual assessments therefor contributed by them, paid back this amount of $2,291.20, as follows: —

Arlington,	$7 86	Nahant,	$2 39
Belmont,	6 36	Newton,	11 24
Boston,	1,896 75	Quincy,	37 21
Chelsea,	53 03	Revere,	15 18
Everett,	32 48	Somerville,	95 80
Hyde Park,	3 44	Watertown,	15 77
Malden,	52 74	Winthrop,	9 04
Melrose,	22 45		
Medford,	29 46	Total,	$2,291 20

At the close of the year 1899 the Treasurer paid back to the several cities and towns in the Metropolitan District the sum of $60,731.22, received up to that time as District entrance fees, etc., in proportion to the 1898 assessments less the credits allowed for water furnished by the cities and towns from their own sources.

The Attorney-General subsequently ruled that the division should have been made in proportion to the gross assessments. A re-distribution was therefore made during the year, with the result that certain cities and towns received small sums additional to the amounts paid in 1899, and other municipalities were assessed certain amounts. The amounts thus paid or assessed are shown by the following table: —

	Amounts paid in 1899.	Amounts which would have been payable based on Gross Assessments.	Assessment to adjust.	Payment to adjust.
Boston, ...	51,650 90	$50,641 95	$1,008 95	-
Chelsea, ...	1,424 06	1,396 20	27 86	-
Everett, ...	867 29	850 30	16 99	-
Malden, ...	1,331 37	1,385 22	-	$53 85
Medford, ...	466 63	774 58	-	307 95
Newton, ...	299 33	293 44	5 89	-
Quincy, ...	579 94	970 98	-	391 04
Somerville, ...	2,577 19	2,526 81	50 38	-
Belmont, ...	128 70	162 38	-	33 68
Hyde Park, ...	91 58	89 74	1 84	-
Melrose, ...	602 76	590 99	11 77	-
Revere, ...	246 38	396 46	-	150 08
Watertown, ...	312 91	415 49	-	102 58
Winthrop, ...	152 18	236 68	-	84 50
	$60,731 22	$60,731 22		

(2) General Statement of Expenditures.

The following is a summary of the expenditures made by the Board in its various operations: —

		For the Year ending December 31, 1900.	From Beginning of Work, and ending December 31, 1900.
Construction.			
Wachusett Dam, Reservoir and Watershed, . . .		$1,091,213 17	$4,417,531 63
Wachusett Aqueduct, ...		13,806 51	1,777,311 67
Sudbury Dam, Reservoir and Watershed, ...		29,285 21	3,124,278 63
Protection of Cochituate supply, ...		6,750 00	6,750 00
Weston Aqueduct and Reservoir, ...		46,970 34	54,775 20
Pipe lines and connections between Framingham Dams No. 3 and No. 1, ...		6 01	48,471 48
Pipe line across Rosemary valley, ...		-	23,142 98
Distribution system, ...	$768,160 46		
Less value of pipes, valves, etc., purchased and sent to store yard in previous years, but transferred to works, and included in cost of same for current year, . . .	16,240 87	751,919 59	4,193,461 93
Other work and operations: —			
Investigations of existing water works systems, and payments on account of same, ...		43,694 82	5,088,421 05
Settlements on account of diversion of water and expenses connected with same, including Clinton sewerage system,		51,456 66	1,040,955 39
Administration and general expenses, ...		25,763 15	147,032 27
Pipes, valves, etc., sent to store yard and not yet transferred to works, ...		-	105,284 61
Maintenance.			
Dam and Aqueduct Department, ...		16,919 49	32,251 09
Sudbury Department, ...		81,656 81	206,057 07
Distribution Department, ...		180,223 28	377,015 29
Administration, general supervision and taxes, . . .		20,343 91	51,130 18
Total expenditures, ...		$2,360,008 95	$20,693,870 47

(3) DETAILED FINANCIAL STATEMENT.

The Board herewith presents, in accordance with the Metropolitan Water Act, an abstract of its expenditures and disbursements, receipts, assets and liabilities for the year 1900: —

(*a*) *Expenditures and Disbursements.*

The total amount of the expenditures and disbursements for the year beginning January 1, 1900, and ending December 31, 1900, is $2,360,008.95; and the total amount from the time of the organization of the Board, on July 19, 1895, to December 31, 1900, is $20,693,870.47. The salaries of the commissioners, and other expenses of administration, have been apportioned to the construction of the works and maintenance and operation of the same, and appear under each of those headings. The following is a division of the expenditures according to their general character: —

GENERAL CHARACTER OF EXPENDITURES.	For the Year ending December 31, 1900.		From Beginning of Work, and ending December 31, 1900.	
I. CONSTRUCTION OF WORKS, AND ACQUISITION BY PURCHASE OR TAKING.				
Administration.				
Commissioners,	$11,600 00		$69,510 27	
Secretary and auditor,	4,958 83		29,081 46	
Clerks and stenographers,	5,466 03		24,157 65	
Legal services,	-		2,359 00	
Travelling,	348 91		1,464 88	
Stationery and printing,	585 27		4,643 82	
Postage, express and telegrams,	263 18		1,345 96	
Furniture and fixtures,	89 28		3,351 81	
Alterations and repairs of buildings,	350 59		2,841 14	
Telephone, lighting, heating, water and care of buildings,	1,266 04		5,409 83	
Rent and taxes, main office,	406 80		406 80	
Miscellaneous expenses,	478 72		2,509 65	
		$25,763 15		$147,032 27
Engineering.				
Chief engineer and department engineers,	$19,638 86		$109,971 85	
Principal assistant engineers,	15,564 70		80,014 64	
Engineering assistants,	112,036 36		569,988 71	
Consulting engineers,	3,485 97		22,187 07	
Inspectors,	22,416 52		136,469 26	
Architects,	4,545 98		24,218 69	
Railroad and street car travel,	3,703 83		18,835 04	
Amounts carried forward,	$181,891 72	$25,763 15	$961,680 26	$147,032 27

GENERAL CHARACTER OF EXPENDITURES.	For the Year ending December 31, 1900.		From Beginning of Work, and ending December 31, 1900.	
Amounts brought forward,	$181,391 72	$25,763 15	$961,680 26	$147,032 27
Engineering — Con.				
Wagon hire,	6,241 63		20,469 11	
Stationery and printing,	2,117 06		16,366 27	
Postage, express and telegrams,	700 30		4,650 27	
Engineering and drafting instruments and tools,	1,062 62		16,045 28	
Engineering and drafting supplies,	2,535 45		17,310 81	
Books, maps and photographic supplies,	467 08		4,314 17	
Furniture and fixtures,	671 54		12,670 98	
Alterations and repairs of building, — main office,	550 60		3,841 95	
Alterations and repairs of building, — sub-offices,	350 87		1,095 16	
Telephone, lighting, heating, water and care of building, — main office,	1,819 17		8,054 91	
Telephone, lighting, heating, water and care of building, — sub-offices,	1,776 08		9,108 21	
Rent and taxes, — main office,	898 35		898 35	
Rent of sub-offices and other buildings,	124 96		2,624 24	
Field offices and sheds,	55 67		820 05	
Clinton office building,	-		9,866 87	
Unclassified supplies,	219 47		4,906 30	
Miscellaneous expenses,	714 43		6,520 66	
Reimbursement, city of Boston,	-	$201,697 00	69,918 69	$1,171,162 54
Construction.				
Preliminary work (borings, soundings, test pits and other investigations): —				
Advertising,	$539 16		$4,525 69	
Labor,	2,965 90		81,123 62	
Medical services, analyses, etc.,	5 00		626 33	
Travelling,	150 50		1,632 88	
Rent,	-		37 00	
Water rates,	-		2,077 30	
Freight and express,	8 00		418 21	
Jobbing and repairing,	17 50		422 17	
Tools, machinery, appliances and hardware supplies,	149 89		15,147 11	
Castings, ironwork and metals,	3 79		136 31	
Iron pipe and valves,	148 60		3,078 71	
Blasting supplies,	-		36 73	
Paint and coating,	-		138 54	
Fuel, oil and waste,	-		547 93	
Lumber and field buildings,	3 00		4,789 26	
Drain pipe,	-		40 80	
Brick, cement and stone,	-		223 19	
Sand, gravel and filling,	-		195 05	
Municipal and corporation work,	-		44 07	
Amounts carried forward,	$3,991 34	$227,460 15	$115,235 90	$1,318,194 81

GENERAL CHARACTER OF EXPENDITURES.	For the Year ending December 31, 1900.		From Beginning of Work, and ending December 31, 1900.	
Amounts brought forward, . . .	$3,991 84	$227,460 15	$115,235 90	$1,318,194 81
Construction — Con.				
Preliminary work, etc. — *Con.*				
Unclassified supplies, ...	-		1,082 60	
Miscellaneous expenses, ...	-		239 69	
Reimbursement, city of Boston, . . .	-	3,991 84	55,404 63	171,962 82
Contracts, Wachusett Reservoir: —				
Joseph D. Gennaro, excavating soil and building road, ... Sect. 1,	-		$11,870 95	
Neill McBride, excavating soil, . Sect. 2,	-		12,067 11	
T. H. Riddle & Co., excavating soil and building road, ... Sect. 3,	-		52,456 96	
Neill Devine & Co., building dike, . Sect. 4, (in part),	-		8,450 11	
Newell & Snowling Construction Co., building road, ... Sect. 4, (in part),	-		6,052 22	
Joseph D. Gennaro, excavations for North Dike, ... Sect. 4, (in part),	-		28,488 01	
Sundry bills under this contract, . .	-		7,824 15	
Moulton & O'Mahoney, grading a railway, Sects. 4 and 6, . . . (in part),	-		9,884 56	
Moulton & O'Mahoney, grading a railway, Sect. 6, ... (in part),	-		2,894 83	
Moulton & O'Mahoney, excavating soil and refilling at North Dike, . . Sect. 4,	$68,280 90		150,989 90	
Long & Little, excavating soil, Sect. 7, and building part of North Dike, . . .	61,081 89		61,081 89	
Newell & Snowling Construction Co., excavating soil from part of . . Sect. 8,	28,763 90		28,763 90	
Newell & Snowling Construction Co., surfacing Boylston Street, . . Sect. 1,	-		11,869 83	
Asa Goddard, surfacing Boylston Street, Sect. 2,	-		11,368 95	
Thomas H. Gill, improving Lancaster Street, West Boylston, ...	-		8,438 87	
Thomas H. Gill, culverts, ...	6,930 21		6,930 21	
Cenedella Bros , excavating soil at Sect. 5, and refilling at North Dike, . . .	39,779 41		82,358 40	
Peter J. O'Malley, excavating soil and building road, West Boylston and Sterling, .	-		20,166 28	
Nawn & Brock, excavating soil, Sect. 6, and building easterly portion of North Dike, .	315,313 00		356,498 35	
Busch Bros., excavating soil, Sect. 6, and building road, West Boylston and Boylston,	14,790 00		34,560 63	
T. Stuart & Son, improving part of Sect. 1, Shrewsbury Road, ...	14,806 59		14,806 59	
Amounts carried forward, ...	$549,745 90	$231,451 49	$922,822 70	$1,490,157 63

GENERAL CHARACTER OF EXPENDITURES.	For the Year ending December 31, 1900.		From Beginning of Work, and ending December 31, 1900.	
Amounts brought forward, . . .	$549,745 90	$231,451 49	$922,822 70	$1,490,157 63
Construction — Con.				
Contracts, Wachusett Reservoir — *Con.*				
Fred E. Ellis, surfacing Sect. 2, Shrewsbury Road, ...	10,454 35		10,454 35	
Fred E. Ellis, surfacing Sect. 3, Shrewsbury Road, ...	9,451 95		9,451 95	
Martin Murphy, transporting soil from St. John's Catholic Cemetery to North Dike,	3,176 60		3,176 60	
Busch Bros., Wachusett Dam, preliminary excavation and masonry, ...	5,372 57		19,120 00	
McArthur Bros., Wachusett Dam, . .	2,550 68	580,752 05	2,550 68	967,576 28
Contracts, Wachusett Aqueduct: —				
E. D. Smith & Co., tunnel, . . Sect. 2,	-		$128,720 11	
E. D. Smith & Co., tunnel and covered masonry, . . . Sect. 3,	-		242,601 06	
Silvio Casparis, covered masonry, Sect. 4,	-		114,167 77	
Silvio Casparis, covered masonry, Sect. 5,	-		100,579 99	
Silvio Casparis, covered masonry, Sect. 6,	-		148,053 49	
Silvio Casparis, covered masonry, Sect. 7,	-		128,802 72	
Jones, Pollard & Co., masonry bridge, ... Sect. 8,	-		64,766 00	
Silvio Casparis, covered masonry, Sect. 9,	-		171,041 07	
Silvio Casparis, covered masonry, Sect. 10,	-		170,252 02	
Moulton & O'Mahoney, open channel, ... Sect. 11,	-		170,050 32	
W. A. Murtfeldt Co., covering Assabet Bridge, ...	-		1,261 00	
J. W. Bishop & Co., superstructure, terminal chamber, ...	-		4,260 00	
New England Granite Works, superstructure, gaging manhole, ...	-	-	1,584 00	1,446,139 55
Contracts, Sudbury Reservoir: —				
Moulton & O'Mahoney, Sudbury Dam, .	-		$297,482 60	
Removal of soil: —				
Auguste Saucier, ... Sect. A,	-		62,183 11	
Moulton & O'Mahoney, ... Sect. B,	-		55,477 93	
Malone & Strang, ... Sect. C,	-		81,070 83	
Auguste Saucier, ... Sect. D,	-		41,567 41	
Charles Linehan, ... Sect. E,	-		32,802 86	
Newell & Snowling, ... Sect. F,	-		26,272 55	
Charles Linehan, ... Sect. G,	-		16,738 23	
Moulton & O'Mahoney, ... Sect. H,	-		34,486 72	
Harry P. Nawn, ... Sect. I,	-		70,343 26	
Moulton & O'Mahoney, ... Sect. J,	-		43,754 13	
Blagen & Bush, ... Sect. K,	-		56,167 62	
Moulton & O'Mahoney, ... Sect. L,	-		78,864 00	
Harry P. Nawn, ... Sect. M,	-		107,879 43	
Amounts carried forward, ...	-	$812,203 54	$1,005,090 68	$3,903,873 46

GENERAL CHARACTER OF EXPENDITURES.	For the Year ending December 31, 1900.		From Beginning of Work, and ending December 31, 1900.	
Amounts brought forward,	-	$812,208 54	$1,005,090 68	$3,908,873 46
Construction — Con.				
Contracts, Sudbury Reservoir — *Con.*				
Removal of soil — *Con.*				
Thomas Nevins & Sons, . . Sect. N,	-		55,227 98	
Washburn & Washburn, . . Sect. O,	-		139,964 83	
Sundry bills paid under this contract,	-		933 51	
Harry P. Nawn, ... Sect. P,	-		86,480 70	
Washburn & Washburn, . . Sect. Q,	-		125,706 29	
Mignault & McGrain, spillway channel,	-		2,350 05	
S. D. Hicks & Son, changing gutter, etc., at gate-house,	-		275 00	
Henry Parsons, iron fence,	-		16,342 96	
John Berry, filter-beds,	-		896 79	
Auguste Saucier, filter-beds,	$3,635 16		39,157 33	
Mignault & McGrain, settling reservoir,	-		2,380 45	
Holbrook, Cabot & Daly, stone arch bridge,	-		33,400 21	
N. Y., N. H. & H. R.R. Co., temporary bridge,	-		6,387 80	
R. D. Wood & Co., sluice gates,	-		4,918 06	
J. W. Bishop & Co., gate-house,	-		17,437 92	
John Evans & Co., granite finial,	-		350 00	
Holbrook, Cabot & Daly, circular dam,	-		4,550 27	
Reimbursement, city of Boston,	-		461,089 26	
		3,635 16		2,002,890 09
Town of Framingham, low-level sewer, protection Cochituate supply,	. . .	6,750 00		6,750 00
Contracts, Rosemary Siphon: —				
A. L. Norton & Co., pipe laying,	-		$4,194 04	
Sundry bills paid under this contract,	-		792 59	
T. Tighe & Sons, teaming pipe,	-		930 83	
		-		5,916 96
Contracts, Pipe Line, Dam No. 3 to Dam No. 1: —				
Harry P. Nawn, pipe laying,	-		$15,269 27	
L. F. Childs, teaming pipe,	-		1,970 95	
		-		17,240 22
Contracts, Clinton Sewerage System: —				
Newell & Snowling Construction Co., Sect. 1,	-		$21,162 62	
O. Cunningham & Son, . . . Sect. 2,	-		10,041 15	
Sundry bills paid under this contract,	-		4,235 43	
Chas N. Taylor, ... Sect. 2,	-		19,739 48	
Cutting, Bardwell & Co, superstructure, pumping station,	-		5,499 54	
Geo. F. Blake Mfg. Co., pumping engine and air pump,	-	-	6,200 00	
				66,878 22
Amounts carried forward,	. . .	$822,588 70		$6,003,548 95

GENERAL CHARACTER OF EXPENDITURES.	For the Year ending December 31, 1900.		From Beginning of Work, and ending December 31, 1900.	
Amounts brought forward,		$822,588 70		$6,003,548 95
Construction — Con.				
Contracts, distribution system: —				
Pipe laying: —				
Malone & McHale, Sect. 1,	-		$6,867 63	
Curnan & Hochstader, Sect. 2,	-		89,517 92	
MacRitchie & Nichol, Sects. 3 and 10,	-		40,507 71	
C. A. & C. E. Trumbull, Sect. 4,	-		6,741 42	
Snyder & Williams, Sects. 4 and 11,	-		48,469 33	
MacRitchie & Nichol, Sect. 5,	-		44,066 34	
Moore & Co. and W. H. Ward, Sect. 6,	-		9,448 65	
Dennis F. O'Connell, Sect. 6,	-		16,644 84	
C. H. Eglee Co., Sects. 6 and 8,	-		61,681 92	
C. H. Eglee Co., Sects. 7 and 13,	-		34,054 41	
E. W. Everson & Co., Sect. 9,	-		17,750 30	
Bruno & Salomone, Sect. 9,	-		5,971 25	
H. A. Hanscom & Co., Sects. 11 and 18,	-		35,508 40	
A. W. Bryne Construction Co., Sect. 13,	-		26,063 89	
Collins & Ham, Sect. 14,	-		11,759 81	
J. H. McKnight, Sect. 15,	-		11,966 06	
George Goodhue, Sect. 16,	-		4,925 11	
H. A. Hanscom & Co., Sect. 16,	-		2,447 12	
H. A. Hanscom & Co., Sect. 17,	-		2,534 72	
Collins & Ham, Sect. 18,	-		10,868 97	
Cheney & Trumbull, Sect. 18,	-		2,561 65	
E. W. Everson & Co., Sect. 19,	-		36,842 54	
Bruno & Salomone, Sect. 19,	-		5,788 38	
H. A. Hanscom & Co., Sect. 20,	-		30,673 90	
Saucier & O'Brien, Sect. 21,	-		13,462 66	
Bruno & Salomone, Sect. 23,	-		9,895 24	
Samuel Frescoln, Sect. 24,	-		8,892 10	
E. W. Everson & Co., Sect. 24,	-		5,050 36	
Michael Russo, Sect. 25,	-		2,663 34	
Mirick & Wentworth, Sect. 26,	-		11,593 68	
W. H. Ryan & Co., water pipe boxes and siphon,	-		4,778 61	
O'Rourke & Nelson, Sect. 27,	-		11,200 66	
Bruno & Salomone, Sect. 28,	-		9,435 26	
H. A. Hanscom & Co., Arlington,	$715 60		1,618 89	
Iron pipe and special castings: —				
R. D. Wood & Co.,	-		299,806 34	
Warren Foundry & Machine Co.,	-		260,457 72	
McNeal Pipe and Foundry Co.,	-		422,609 16	
Camden Iron Works,	-		352,167 28	
Addyston Pipe & Steel Co.,	-		30,473 48	
Howard-Harrison Iron Co.,	-		156,628 28	
United States Cast Iron Pipe & Foundry Co.,	-		1,551 35	
Amounts carried forward,	$715 60	$822,588 70	$2,115,941 68	$6,003,548 95

GENERAL CHARACTER OF EXPENDITURES.	For the Year ending December 31, 1900.		From Beginning of Work, and ending December 31, 1900.	
Amounts brought forward, . . .	$715 60	$822,588 70	$2,115,941 68	$6,003,548 95
Construction — Con.				
Contracts, distribution system — *Con.*				
Valves and sluice gates: —				
Coffin Valve Co., ...	3,990 00		14,436 00	
Josiah H. Long, ...	-		14,008 00	
Kennedy Valve Mfg. Co., ...	-		11,390 00	
The Atlantic Works, ...	4,169 15		14,395 00	
Pipe bridges: —				
New Jersey Steel & Iron Co., over Mystic River, ...	-		3,980 00	
Cheney & Trumbulls, over Mystic River, .	-		3,570 28	
New Jersey Steel & Iron Co., over Nashua River, ...			1,875 00	
David H. Andrews, over Boston & Maine Railroad, ...	-		2,497 00	
Pittsburg Bridge Co., over Boston & Maine Railroad, ...	-		3,097 00	
Boston Bridge Works, over Boston & Albany Railroad, ...	-		1,500 00	
Iron and steel work: —				
Chelmsford Foundry Co., cast-iron frames and covers, ...	-		1,841 61	
Davis & Farnum Mfg. Co., cast-iron frames and covers, ...	-		998 04	
New Jersey Steel & Iron Co., steel works for valve chamber, ...	-		2,132 55	
Edward Kendall & Sons, ironwork for pumping station, ...	-		3,199 32	
New England Structural Co., steel work for valve chambers, ...	-		1,496 00	
Chelmsford Foundry Co., iron floor plates, Chestnut Hill and Spot Pond, . . .	1,090 00		1,090 00	
Reservoirs and standpipe: —				
T. W. Kinser & Sons, high-service reservoir, Middlesex Fells, ...	-		30,972 29	
Sundry bills under this contract, . .	-		5,066 19	
Nawn & Brock, completing high-service reservoir, ...	-		68,836 40	
Beckwith & Quackenbush, reservoir and foundation for standpipe at Forbes Hill, .	12,518 05		12,518 05	
Walsh's Holyoke Steam Boiler Works, standpipe at Forbes Hill, ...	3,761 25		3,761 25	
Spot Pond works: —				
McNeil Bros., high-service pumping station and gate-house, ...	37,853 84		114,407 10	
Newell & Snowling Construction Co., Sect. 1,	14,678 18		49,458 28	
Moulton & O'Mahoney, . . . Sect. 2,	13,703 44		45,692 05	
Amounts carried forward, ...	$92,479 51	$822,588 70	$2,528,159 09	$6,003,548 95

GENERAL CHARACTER OF EXPENDITURES.	For the Year ending December 31, 1900.		From Beginning of Work, and ending December 31, 1900.	
Amounts brought forward, . . .	$92,479 51	$822,588 70	$2,528,159 09	$6,003,548 95
Construction — Con.				
Contracts, distribution system — *Con.*				
Spot Pond works — *Con.*				
Newell & Snowling Construction Co., Sect. 3,	42,661 43		53,342 15	
Moulton & O'Mahoney, . . . Sect. 4,	54,121 51		72,825 86	
Sundry bills under this contract, . .	12,175 34		12,175 34	
P. H. Fitzgerald, ... Sect. 6,	22,608 34		52,557 44	
Newell & Snowling Construction Co., Sect. 7,	16,665 93		16,665 93	
Brodhead Contracting Co., dams, . . .	7,947 34		34,004 75	
Holly Manufacturing Co., high-service pumping station, ...	46,875 00		46,875 00	
C. H. Eglee Co., gate-house and connections,	-		21,559 74	
C. E. Trumbull, drainage system, . . .	-		24,099 75	
Glenwood pipe yard: —				
W. L. Clark & Co., stable, ...	7,308 82		21,808 82	
Lynn Stall Co., stable fittings, . . .	117 00		317 00	
Thomas W. Byrne, electric wiring, stables,	168 70		168 70	
Lynch & Woodward, heating and ventilating stables, ...	719 00		719 00	
Boilers and piping: —				
Lake Erie Boiler Works, Belpaire boiler, Chestnut Hill high-service pumping station, ...	-		13,650 00	
The Atlantic Works, fire tube boilers, . .	14,710 00		19,950 00	
American Stoker Co., stokers on Belpaire boilers, ...	760 00		2,760 00	
Lake Erie Boiler Works, vertical fire tube boilers, ...	5,851 25		22,388 75	
W. H. Gallison Co., steam piping, . .	-		1,637 25	
H. W. Johns Manufacturing Co., asbestos covering, ...	-		234 20	
Fuel Economizer Co., fuel economizer, .	1,643 00		3,286 00	
Pumping engines: —				
E. P. Allis Co., Chestnut Hill high-service,	54,061 50		139,561 50	
Holly Manufacturing Co., Chestnut Hill low-service, ...	102,375 00		116,025 00	
Travelling cranes: —				
Brown Hoisting and Conveying Machinery Co., hand travelling crane, ...	-		1,930 00	
New England Structural Co., hand travelling crane, ...	200 00		5,544 00	
Gate-houses, etc.: —				
W. L. Clark & Co., gate-house, northern high-service reservoir, ...	2,646 00		5,242 00	
Baker & Judson, gate-chamber and connections, Chestnut Hill Reservoir, . . .	5,674 80		19,502 34	
John S. Jacobs & Son, southern gate-house, Medford, ...	4,400 00		4,400 00	
Amounts carried forward, ...	$496,169 47	$822,588 70	$3,241,389 61	$6,003,548 95

GENERAL CHARACTER OF EXPENDITURES.	For the Year ending December 31, 1900.		From Beginning of Work, and ending December 31, 1900.	
Amounts brought forward,	$496,169 47	$822,588 70	$3,241,389 61	$6,003,548 95
Construction — Con.				
Contracts, distribution system — *Con.*				
Gate-houses, etc. — *Con.*				
John S. Jacobs & Son, southern gate-house, Chestnut Hill Reservoir,	5,600 00		5,600 00	
Pumping stations: —				
C. A. Dodge & Co., addition to Chestnut Hill pumping station,	-		48,694 62	
Norcross Bros., Chestnut Hill low-service pumping station,	53,066 04		192,445 66	
Hugh Cairns, stone carving on pumping station,	-		214 00	
Charles E. Hall & Co., marble about pump well and staircase, Chestnut Hill pumping station,	-		190 00	
S. Brennan & Co., tile floor, pump room, Chestnut Hill station,	639 00		639 00	
Westinghouse Electric and Mfg. Co., electric generators,	346 00		1,346 00	
Fitchburg Steam Engine Co., engine for electric light plant, low-service pumping station,	741 00		741 00	
Moore & Wyman, hydraulic plunger elevator,	720 00		720 00	
Mirick & Wentworth, laying sewer pipe, Chestnut Hill pumping station,	934 24		934 24	
	$558,215 75		$3,492,914 13	
Deduct value of pipes, valves, etc., included in above list, since transferred to maintenance account and shown on page 58,	318 88	557,896 87	3,139 77	3,489,774 36
Additional work: —				
Labor,	$117,291 10		$436,118 93	
Medical services, analyses, etc.,	407 44		1,007 04	
Travelling,	185 00		872 57	
Rent,	341 00		2,597 37	
Water rates,	410 90		606 85	
Freight and express,	1,883 76		7,804 54	
Jobbing and repairing,	1,782 81		6,561 41	
Tools, machinery, appliances and hardware supplies,	20,781 00		57,260 92	
Electrical supplies,	2,688 01		2,688 01	
Castings, ironwork and metals,	12,348 88		38,482 00	
Iron pipe and valves,	10,422 46		37,835 56	
Blasting supplies,	87 66		859 41	
Paint and coating,	637 99		3,485 84	
Fuel, oil and waste,	2,616 90		5,560 20	
Lumber and field buildings,	17,734 68		70,058 98	
Drain pipe,	1,428 28		4,173 84	
Amounts carried forward,	$191,047 87	$1,380,485 57	$675,973 47	$9,493,323 31

GENERAL CHARACTER OF EXPENDITURES.	For the Year ending December 31, 1900.		From Beginning of Work, and ending December 31, 1900.	
Amounts brought forward, ...	$191,047 87	$1,380,485 57	$675,978 47	$9,493,323 31
Construction — Con.				
Contracts, distribution system — *Con.*				
Additional work — *Con.*				
Brick, cement and stone, ...	3,319 62		11,740 12	
Sand, gravel and filling, ...	1,512 29		4,132 94	
Municipal and corporation work, . . .	5,549 18		64,266 37	
Police service, ...	16,062 70		100,874 16	
Sanitary inspection, ...	750 00		5,228 61	
Judgments, ...	4,591 13		5,591 13	
Unclassified supplies, ...	2,637 93		7,003 22	
Miscellaneous expenses, ...	3,629 95		8,301 51	
Reimbursement, city of Boston, . . .	-	229,100 67	21,765 87	904,877 40
Legal and expert: —				
Legal services, ...	$1,250 00		$4,618 82	
Expert services, ...	-		475 87	
Court expenses, ...	295 45		353 31	
Miscellaneous expenses, ...	-	1,545 45	33 35	5,481 35
Real Estate.				
Legal and expert: —				
Legal services, ...	-		$4,736 31	
Conveyancer and assistants, ...	$9,640 41		68,879 40	
Experts, ...	1,357 50		15,375 40	
Appraisers, ...	3,158 70		13,162 34	
Court expenses, ...	600 17		1,401 15	
Counsel expenses, ...	-		48 25	
Conveyancing supplies, ...	246 49		2,780 67	
Conveyancing expenses, ...	782 37		3,939 64	
Miscellaneous expenses, ...	124 75		871 20	
Reimbursement, city of Boston, . . .	-		15,021 25	
Settlements, made by Board, ...	228,778 71		2,751,374 73	
Settlements, reimbursement, city of Boston, .	-		531,606 00	
Judgments, ...	6,946 79		21,437 47	
Taxes and tax equivalents, ...	20,041 89		68,099 81	
Care and disposal, ...	13,791 02	285,418 80	22,848 64	3,521,576 76
Damages to Real Estate not taken, to Business, and on Account of Loss of Wages.				
Legal and expert services, ...	-		$1,130 67	
Settlements, ...	$68,289 23	68,289 23	112,397 91	113,528 58
Claims on Account of Diversion of Water.				
Legal and expert: —				
Legal services, ...	$25 00		$3,774 98	
Expert services, ...	162 00		11,734 17	
Miscellaneous expenses, ...	17 00		298 10	
Settlements, ...	33,000 00	33,204 00	882,350 00	898,157 25
Amounts carried forward, ...	. . .	$1,998,043 72		$14,936,944 65

GENERAL CHARACTER OF EXPENDITURES.	For the Year ending December 31, 1900.		From Beginning of Work, and ending December 31, 1900.	
Amounts brought forward,	. . .	$1,998,043 72		$14,936,944 65
Purchase of Existing Water Works.				
Legal and expert: —				
Legal services,	$43 05		$1,878 89	
Expert services,	1,803 15		1,890 65	
Miscellaneous expenses,	225 83		952 94	
Settlements,	60,749 71	62,821 74	5,085,749 71	5,090,472 19
		$2,060,865 46		$20,027,416 84
II. MAINTENANCE AND OPERATION OF WORKS.				
Administration: —				
Commissioners,	$2,400 00		$7,200 00	
Secretary, auditor and assistants,	4,516 49		13,320 99	
Postage, printing, stationery and other supplies,	504 14		1,134 62	
Travelling,	203 13		382 96	
Telephone, heating, lighting and care of building,	651 78		1,415 20	
Alterations and repairs of building,	70 00		70 00	
Rent and taxes, office building,	130 60		130 60	
Miscellaneous expenses,	76 15		222 87	
Supervision and general superintendence: —				
Chief engineer and department engineers,	7,842 00		18,663 67	
Engineering and clerical assistants,	7,314 17		18,623 14	
Postage, printing, stationery and office supplies,	560 42		1,714 78	
Telephone, heating, lighting, and care of offices,	1,127 30		2,759 84	
Travelling and incidental expenses,	465 23		1,545 12	
Alterations and repairs of buildings,	200 00		1,073 02	
Rent and taxes, main office,	224 59		224 59	
Miscellaneous expenses,	196 81		489 97	
Pumping service: —				
Labor,	35,759 28		88,170 70	
Fuel,	42,944 30		79,436 59	
Oil, waste and packing,	1,780 68		3,364 44	
Repairs and renewals,	7,216 43		10,905 88	
Small supplies and expenses,	2,240 42		5,470 26	
Pumping by municipalities,	13,215 00		45,273 80	
Rent, West Roxbury Pumping Station,	920 00		920 00	
Superintendents and assistant superintendents,	2,760 64		8,413 33	
Engineering assistants,	8,426 47		20,647 41	
Laboratory force,	2,597 45		7,961 37	
Sanitary inspectors,	2,358 96		7,226 68	
Recording and scientific instruments and supplies,	649 11		1,629 18	
Labor and teaming,	80,056 83		193,478 46	
Tools, machinery and appliances,	1,685 68		5,716 17	
Amounts carried forward,	$229,094 06	$2,060,865 46	$547,585 64	$20,027,416 84

GENERAL CHARACTER OF EXPENDITURES.	For the Year ending December 31, 1900.		From Beginning of Work, and ending December 31, 1900.	
Amounts brought forward,	$229,094 06	$2,060,865 46	$547,585 64	$20,027,416 84
MAINTENANCE, ETC. — *Con.*				
Lumber and hardware supplies,	3,285 36		5,794 55	
Jobbing and repairing,	2,675 18		6,042 48	
Travelling,	2,927 89		6,549 18	
Horses, vehicles and stable expenses,	4,001 66		9,938 31	
Fuel, exclusive of pumping service,	2,307 80		5,235 90	
Municipal and corporation work,	1,838 18		3,550 67	
Alterations and repairs of buildings,	-		402 97	
Settlements of claims,	-		1,000 00	
Conveyancer and assistants,	302 00		302 00	
Taxes and tax equivalents,	9,280 61		20,799 27	
Contracts and agreements,	36,855 42		40,914 85	
Contracts for pipes, valves, etc., originally charged to construction, since transferred to maintenance (included in list, pages 52–55),	318 88		3,139 77	
Unclassified supplies,	4,185 06		10,408 84	
Miscellaneous expenses,	2,071 99		4,789 20	
		299,143 49		666,453 63
Total expenditures,	. . .	$2,360,008 95		$20,693,870 47

The following division will show the cost of the different works : —

EXPENDITURES FOR DIFFERENT WORKS.	For the Year ending December 31, 1900.		From Beginning of Work, and ending December 31, 1900.	
General administration applicable to all parts of the construction and acquisition of the works,	. . .	$25,763 15		$147,032 27
Wachusett Dam and Reservoir.				
Wachusett Dam : —				
Engineering,	$25,534 22		$72,563 62	
Preliminary work,	445 37		24,518 93	
Contracts,	7,940 09		18,290 31	
Additional work,	35,175 07		37,806 39	
Contracts, temporary works,	-		11,394 81	
Additional work, temporary works,	11,998 31		106,500 12	
North Dike, engineering,	17,663 85		67,196 67	
preliminary work,	30 65		27,846 48	
contracts,	121,060 18		221,736 68	
additional work,	82,152 37		102,028 65	
South Dike, engineering,	39 00		1,232 20	
preliminary work,	-		2,485 98	
additional work,	51 00		106 00	
Amounts carried forward,	$252,090 11	$25,763 15	$693,706 84	$147,032 27

EXPENDITURES FOR DIFFERENT WORKS.	For the Year ending December 31, 1900.		From Beginning of Work, and ending December 31, 1900.	
Amounts brought forward,	$252,090 11	$25,763 15	$693,706 84	$147,032 27
Wachusett Dam and Reservoir — Con.				
Removal of soil, engineering,	36,878 05		86,688 73	
preliminary work,	967 29		29,549 43	
contracts,	392,935 95		551,606 89	
additional work,	8,781 73		17,663 06	
Relocation of railroads, engineering,	526 80		6,425 35	
preliminary work,	228 51		235 38	
additional work,	16 00		126 00	
Roads and bridges, engineering,	17,044 24		58,166 89	
preliminary work,	154 44		876 24	
contracts, roads,	58,963 73		172,722 05	
additional work,	15,306 98		44,478 41	
Real estate: —				
Engineering,	5,559 73		48,072 53	
Legal, conveyancing and expert,	10,399 37		80,006 02	
Mill property and water rights,	30,000 00		1,340,700 00	
Other property for reservoir and margins: —				
Clinton,	60,551 32		220,789 34	
Boylston,	36,419 02		200,104 32	
West Boylston,	46,550 00		607,245 00	
Sterling,	850 00		23,995 75	
Outlying property: —				
Clinton,	-		5,559 00	
Boylston,	375 00		785 00	
West Boylston,	5,885 00		7,915 00	
Sterling,	75 00		75 00	
Lancaster,	-		11,678 66	
Taxes and tax equivalents,	20,013 88		61,284 60	
Care and disposal,	12,463 53		20,749 70	
Damages, real estate not taken: —				
Clinton,	3,125 00		3,125 00	
Boylston,	25 00		25 00	
West Boylston,	16,810 00		19,585 00	
Decrease of business: —				
Boylston,	800 00		800 00	
West Boylston,	12,710 00		40,970 00	
Sterling,	-		160 00	
Damages, loss of wages: —				
West Boylston,	34,819 23		47,732 91	
Legal and expert (except in real estate),	-	1,081,324 91	1,130 67	4,404,728 77
Improving Wachusett Watershed.				
Swamp drainage, engineering,	$4,136 23		$5,890 98	
preliminary work,	-		40 00	
additional work,	4,489 29		5,599 14	
Sewerage systems, engineering,	1,224 84		1,224 84	
Legal, conveyancing and expert,	37 90	9,888 26	47 90	12,802 86
Amounts carried forward,	. . .	$1,116,976 32		$4,564,563 90

EXPENDITURES FOR DIFFERENT WORKS.	For the Year ending December 31, 1900.		From Beginning of Work, and ending December 31, 1900.	
Amounts brought forward,	. . .	$1,116,976 32		$4,564,563 90
Wachusett Aqueduct.				
Engineering,	$1,377 06		$162,632 17	
Preliminary work,	-		3,545 79	
Contracts, tunnel,	-		342,005 80	
covered masonry,	-		859,466 21	
Assabet bridge,	-		66,239 46	
terminal chamber,	-		8,641 60	
open channel,	-		170,050 82	
Additional work,	3,793 85		84,091 84	
Legal, conveyancing and expert,	309 85		11,192 74	
Real estate: —				
Property and easements: —				
Berlin,	3,050 00		13,407 50	
Clinton,	-		18,200 00	
Northborough,	-		23,301 40	
Marlborough,	875 00		3,682 50	
Southborough,	4,146 00		9,921 00	
Boylston,	200 00		200 00	
Taxes, care and disposal,	54 75		733 34	
		13,806 51		1,777,311 67
Sudbury Dam and Reservoir.				
Dam, engineering,	-		$45,965 78	
preliminary work,	-		4,766 88	
contracts, core wall,	-		88,773 86	
embankment,	-		127,574 66	
masonry section,	-		327,027 27	
gate-house superstructure,	-		18,062 92	
sluice gates and ironwork,	-		4,918 06	
spillway channel,	-		2,350 05	
additional work,	-		28,970 90	
Reservoir, engineering,	$537 48		126,948 12	
preliminary work,	-		51,413 54	
contracts, removal of soil and deepening,	-		1,158,945 78	
roads and railroads,	-		217,245 90	
regulating dam,	-		4,550 27	
additional work,	652 84		62,726 66	
Legal, conveyancing and expert,	324 20		22,296 87	
Real estate, property,	1,349 00		620,692 43	
taxes, care and disposal,	-		6,879 56	
		2,863 52		2,920,109 46
Protection of Sudbury Supply (Filter-beds and Other Works).				
Engineering,	$1,943 82		$16,775 52	
Preliminary work,	-		1,377 83	
Contracts,	3,635 16		53,441 32	
Additional work,	5,455 53		6,958 02	
Legal, conveyancing and expert,	-		236 30	
Real estate,	-		37,626 32	
		11,034 51		116,415 31
Amounts carried forward,	. . .	$1,144,680 86		$9,378,400 34

EXPENDITURES FOR DIFFERENT WORKS.	For the Year ending December 31, 1900.		From Beginning of Work, and ending December 31, 1900.	
Amounts brought forward,		$1,144,680 86	-	$9,378,400 34
Protection of Cochituate Supply.				
Contracts,		6,750 00		6,750 00
Improving Sudbury Watershed (Swamp Drainage and Similar Work).				
Engineering,	$5,274 62		$21,203 62	
Preliminary work,	-		831 74	
Additional work (day work),	8,756 84		53,965 53	
Legal, conveyancing and expert,	86 12		811 87	
Real estate,	1,269 60	15,387 18	10,941 10	87,753 86
Pipe Lines and Connections between Framingham Dams No. 3 and No. 1.				
Engineering,	-		$2,528 19	
Preliminary work,	-		239 58	
Contracts,	$6 01		44,421 29	
Additional work,	-	6 01	1,282 42	48,471 48
Pipe Line across Rosemary Valley.				
Engineering,	-		$2,010 12	
Preliminary work,	-		24 62	
Contracts,	-		20,426 91	
Additional work,	-	-	681 33	23,142 98
Weston Aqueduct and Reservoir.				
Aqueduct and reservoir, engineering,	$15,626 63		$22,768 70	
preliminary work,	2,044 41		2,707 20	
Supply pipe line, engineering,	432 94		432 94	
Real estate property and easements,	27,653 50		27,653 50	
Taxes,	28 01		28 01	
Legal, conveyancing and expert,	1,184 85	46,970 34	1,184 85	54,775 20
Distribution System.				
Low service: —				
Pipe lines and connections: —				
Engineering,	$8,583 14		$100,231 12	
Preliminary work,	57 36		8,520 60	
Contracts, Sect. 1,	7,651 03		42,716 15	
Sect. 2,	440 04		179,826 95	
Sect. 3,	67 74		32,745 87	
Sect. 4,	376 80		202,464 78	
Sect. 5,	10 07		49,153 03	
Sect. 6,	138 19		137,007 96	
Sect. 7,	41 23		131,901 46	
Sect. 8,	73 81		139,747 91	
Sect. 9,	252 86		108,998 48	
Sect. 10,	30 12		20,376 11	
Amounts carried forward,	$17,722 39	$1,213,794 39	$1,153,690 42	$9,599,293 86

EXPENDITURES FOR DIFFERENT WORKS.		For the Year ending December 31, 1900.		From Beginning of Work, and ending December 31, 1900.	
Amounts brought forward,		$17,722 39	$1,218,794 39	$1,153,690 43	$9,599,293 86
Distribution System—Con.					
Low service—*Con.*					
Pipe lines and connections—*Con.*					
Contracts,	Sect. 11,	-		143,365 82	
	Sect. 12,	7,634 28		22,291 78	
	Sect. 28,	399 43		37,202 44	
Additional work,		5,825 74		47,059 69	
Additional work,	Sect. 1,	10,197 74		13,989 57	
	Sect. 2,	143 55		3,385 98	
	Sect. 3,	-		39 55	
	Sect. 4,	4 50		11,042 11	
	Sect. 5,	-		13 70	
	Sect. 6,	14 11		1,965 54	
	Sect. 7,	528 86		4,960 95	
	Sect. 8,	-		4,144 62	
	Sect. 9,	88 57		2,645 20	
	Sect. 10,	-		10 69	
	Sect. 11,	6,245 85		11,217 69	
	Sect. 12,	468 14		1,218 14	
	Sect. 28,	449 74		2,422 05	
Pumping station, Chestnut Hill:—					
Engineering,		5,619 37		36,836 74	
Preliminary work,		-		146 10	
Contracts, building,		59,872 46		208,341 68	
engines,		103,359 63		117,009 63	
boilers,		14,710 00		21,593 00	
lighting and heating,		1,087 00		2,087 00	
Additional work,		408 73		5,327 17	
Additional work, building,		2,413 29		3,029 25	
engines,		1,555 57		1,600 22	
boilers,		1,866 61		2,039 55	
piping,		3,887 86		6,862 23	
lighting and heating,		5,343 59		5,343 59	
Reservoir (Spot Pond):—					
Engineering,		26,705 17		81,170 42	
Preliminary work,		6 75		6,250 32	
Contracts, earthwork,		172,446 17		290,418 27	
core wall,		5,392 74		26,059 91	
gate-houses and inlets,		2,983 12		46,430 64	
drainage system,		10,253 69		33,413 86	
Additional work,		13,312 51		36,101 52	
Additional work, earthwork,	Sect. 5,	2,139 76		44,851 28	
Gate-house and connections, Chestnut Hill Reservoir:—					
Engineering,		1,797 88		4,667 78	
Preliminary work,		-		7 13	
Contracts,		12,278 35		50,457 80	
Additional work,		1,143 46		2,041 09	
Amounts carried forward,		$498,306 61	$1,218,794 39	$2,492,752 12	$9,599,293 86

EXPENDITURES FOR DIFFERENT WORKS.	For the Year ending December 31, 1900.		From Beginning of Work, and ending December 31, 1900.	
Amounts brought forward, . . .	$498,306 61	$1,213,794 39	$2,492,752 12	$9,599,293 86
Distribution System — Con.				
Low service — *Con.*				
Gate-house and connections, Chestnut Hill Reservoir — *Con.*				
Real estate, ...	6,715 56		72,229 56	
Legal, conveyancing and expert, . . .	2,998 25		5,622 47	
	$508,020 42			2,570,604 15
Less credit by stock returned, . Sect. 11,	187 70	507,832 72		
Northern high service: —				
Pipe lines and connections: —				
Engineering, ...	$3,641 17		$39,485 19	
Preliminary work, ...	-		1,588 30	
Contracts, ... Sect. 13,	1,039 54		82,234 51	
Sect. 14,	46 48		39,729 45	
Sect. 15,	70 24		41,512 77	
Sect. 16,	218 42		24,114 48	
Sect. 17,	6 78		7,050 97	
Sect. 18,	83 79		52,584 66	
Sect. 26,	85 57		41,250 27	
Sect. 27,	829 89		28,559 26	
Additional work, ...	768 41		10,301 83	
Additional work, ... Sect. 13,	496 80		1,447 51	
Sect. 14,	291 00		3,181 98	
Sect. 15,	65		632 28	
Sect. 16,	252 47		650 05	
Sect. 17,	300 48		424 22	
Sect. 18,	-		1,101 99	
Sect. 26,	1,212 65		4,224 55	
Sect. 27,	874 01		4,780 88	
Pumping station at Spot Pond: —				
Engineering, ...	4,418 11		20,729 41	
Preliminary work, ...	-		37 00	
Contracts, building, ...	35,249 92		122,572 69	
engines, ...	47,004 00		47,004 00	
boilers, ...	7,494 25		24,031 75	
piping, ...	1,116 86		1,116 86	
Additional work, ...	39 46		1,035 41	
Additional work, building, . . .	2,278 99		3,159 01	
engines, ...	19,124 47		21,885 87	
boilers, ...	1,513 67		1,663 33	
piping, ...	1,403 66		2,344 68	
lighting and heating, .	2,346 11		2,346 11	
Reservoir in Middlesex Fells: —				
Engineering, ...	1,285 54		20,766 64	
Preliminary work, ...	-		889 65	
Contracts, ...	2,653 68		114,215 75	
Additional work, ...	1,817 89		4,661 39	
Amounts carried forward, ...	$137,964 96	$1,721,627 11	$773,314 70	$12,169,898 01

EXPENDITURES FOR DIFFERENT WORKS.		For the Year ending December 31, 1900.		From Beginning of Work, and ending December 31, 1900.	
Amounts brought forward,		$137,964 96	$1,721,627 11	$773,814 70	$12,169,898 01
Distribution System — Con.					
Northern high service — *Con.*					
Reservoir on Bear Hill: —					
Engineering,		512 56		512 56	
Real estate,		-		13,200 00	
Legal, conveyancing and expert,		651 45	139,128 97	1,165 00	788,192 26
Southern high service: —					
Pipe lines and connections: —					
Engineering,		$1,294 19		$37,102 04	
Preliminary work,		-		1,928 26	
Contracts,	Sect. 19,	666 39		172,548 49	
	Sect. 20,	-		110,403 35	
	Sect. 21,	663 56		48,858 13	
	Sect. 23,	75 73		42,670 49	
	Sect. 24,	251 80		87,932 15	
	Sect. 25,	15 94		9,271 09	
Additional work,		2,072 44		25,324 63	
Additional work,	Sect. 19,	936 28		6,000 03	
	Sect. 20,	3 00		1,376 45	
	Sect. 21,	655 36		2,243 80	
	Sect. 22,	-		81 00	
	Sect. 23,	176 24		1,204 27	
	Sect. 24,	122 90		3,315 65	
	Sect. 25,	-		609 28	
Pumping station, Chestnut Hill: —					
Engineering,		1,559 98		16,134 13	
Preliminary work,		-		96 93	
Contracts, building,		1,846 24		54,212 19	
engines,		54,061 50		139,561 50	
boilers,		760 00		16,410 00	
piping,		-		1,871 45	
travelling crane,		-		1,930 00	
Additional work,		1,552 51		10,290 22	
Reservoir in Quincy: —					
Engineering,		5,903 04		8,801 41	
Preliminary work,		56 56		148 41	
Contracts, reservoir,		13,314 85		13,590 25	
standpipe,		3,917 25		3,917 25	
Additional work,		1,926 09		2,021 09	
Real estate,		-		7,765 00	
Legal, conveyancing and expert,		-		2,452 84	780,071 78
		$91,831 85			
Less credit by stock returned,		33 95	91,797 90		
Northern extra high service: —					
Engineering,		$223 46		$1,710 84	
Preliminary work,		-		37 75	
Amounts carried forward,		$223 46	$1,952,553 98	$1,748 59	$13,738,162 05

EXPENDITURES FOR DIFFERENT WORKS.	For the Year ending December 31, 1900.		From Beginning of Work, and ending December 31, 1900.	
Amounts brought forward, . . .	$223 46	$1,952,553 98	$1,748 59	$13,738,162 05
Distribution System — Con.				
Northern extra high service — *Con.*				
Pipe lines and connections: —				
Contracts, ...	340 51		796 01	
Additional work, ...	217 19		460 05	
Pumping station in Arlington: —				
Additional work, building, ...	1,116 59		1,158 83	
engines, ...	374 47		3,210 42	
boilers, ...	1,011 76		1,029 01	
piping, ...	1,057 16		1,144 95	
Real estate, ...	-		2,400 00	
Legal, conveyancing and expert, . . .	-	4,341 14	31 65	11,979 51
Southern extra high service: —				
Engineering, ...	$51 97	51 97	$368 63	368 63
Glenwood pipe yard: —				
Engineering, ...	$1,077 19		$1,600 95	
Additional work, ...	1,937 93		1,962 69	
Contracts, buildings, ...	12,764 66		23,064 66	
Real estate, ...	-	15,779 78	6,889 32	33,017 62
Chestnut Hill pipe yard: —				
Pipe yard and grounds, additional, . .	$9,227 98	9,227 98	$9,227 98	9,227 98
Diversion of Water, South Branch of Nashua River.				
Engineering, ...	$3,440 70		$17,786 56	
Legal, conveyancing and expert, . . .	1,555 85		19,391 23	
Settlements, ...	33,000 00		882,350 00	
Clinton sewerage system: —				
Engineering, ...	414 29		19,083 16	
Preliminary, ...	-		1,852 75	
Contracts, ...	-		71,269 83	
Additional work, ...	2,011 58		9,987 62	
Real estate, ...	9,761 50		17,961 50	
care and disposal, . . .	1,272 74	51,456 66	1,272 74	1,040,955 39
Examinations of Existing Water Works, and Payments on Account of Same.				
Engineering, ...	$1,369 73		$15,448 04	
Legal, conveyancing and expert, . . .	2,134 03	3,503 76	7,781 95	23,229 99
Settlements, ...	$60,749 71		$5,085,749 71	
Transfers of engines, boilers and other property from works purchased to other portions of the work and included in the above accounts, ...	20,558 65	40,191 06	20,558 65	5,065,191 06
Amounts carried forward, ...	. . .	$2,077,106 33		$19,922,132 23

EXPENDITURES FOR DIFFERENT WORKS.	For the Year ending December 31, 1900.		From Beginning of Work, and ending December 31, 1900.	
Amounts brought forward,	. . .	$2,077,106 33		$19,922,132 23
Pipes, Valves, Castings, etc., sent first to Storage Yards, and afterwards transferred as needed to Different Parts of the Work.				
Sent to storage yards,	$10,494 71		$1,571,905 48	
Transferred from storage yards to works, and included in costs above,	26,735 58		1,466,620 87	
Balance from beginning of work,	. . .			105,284 61
Excess of transfers over purchases during the year 1900 (deducted),	. . .	16,240 87		
Maintenance and Operation.		$2,060,865 46		$20,027,416 84
Administration,	. . .	8,552 29		23,877 24
General supervision: —				
Services,	$1,928 15		$5,188 65	
Supplies and expenses,	280 86	2,209 01	963 02	6,151 67
Legal, conveyancing and expert,	. . .	302 00		302 00
Taxes,	. . .	9,280 61		20,799 27
Dam and aqueduct department: —				
General superintendence: —				
Services,	$2,117 00		$4,199 48	
Supplies and expenses,	431 34		1,003 40	
Dam and aqueduct: —				
Labor,	8,411 34		17,950 72	
Supplies and expenses,	1,381 44		2,963 38	
Clinton sewerage system: —				
Pumping station: —				
Labor,	1,077 65		1,426 65	
Fuel,	882 29		1,083 02	
Repairs and supplies,	311 57		452 70	
Sewers, screens and filter-beds: —				
Labor,	1,757 76		2,026 27	
Repairs and supplies,	252 11		270 33	
Sanitary inspection: —				
Labor,	256 74		758 77	
Supplies and expenses,	40 25	16,919 49	116 37	32,251 09
Sudbury department: —				
General superintendence: —				
Services,	$5,352 93		$15,573 24	
Supplies and expenses,	850 51		3,280 30	
Superintendence, Framingham office: —				
Labor,	5,064 65		13,895 84	
Supplies and expenses,	1,197 71		2,522 33	
Sudbury Reservoir: —				
Labor,	6,553 96		14,327 40	
Supplies and expenses,	4,000 65		6,860 49	
Ashland Reservoir: —				
Labor,	1,315 31		3,582 02	
Supplies and expenses,	572 20		1,117 40	
Amounts carried forward,	$24,907 92	$2,098,128 86	$61,159 02	$20,110,798 11

EXPENDITURES FOR DIFFERENT WORKS.	For the Year ending December 31, 1900.		From Beginning of Work, and ending December 31, 1900.	
Amounts brought forward,	$24,907 92	$2,098,128 86	$61,159 02	$20,110,798 11
Maintenance and Operation — Con.				
Sudbury department — *Con.*				
Hopkinton Reservoir: —				
Labor,	1,885 91		5,518 09	
Supplies and expenses,	661 10		1,586 67	
Whitehall Reservoir: —				
Labor,	279 98		734 48	
Supplies and expenses,	261 49		436 78	
Framingham Reservoirs, 1, 2 and 3: —				
Labor,	3,842 31		10,339 06	
Supplies and expenses,	2,103 75		4,089 59	
Lake Cochituate: —				
Labor,	3,092 68		7,544 54	
Supplies and expenses,	651 90		1,471 55	
Marlborough Brook filters: —				
Labor,	2,900 18		2,900 18	
Supplies and expenses,	380 39		380 39	
Pegan filters: —				
Labor,	1,870 14		6,317 47	
Supplies and expenses,	663 09		2,346 94	
Sudbury and Cochituate watersheds: —				
Labor,	91 75		538 75	
Supplies and expenses,	144 55		581 95	
Sanitary inspection: —				
Labor,	2,079 22		6,562 26	
Supplies and expenses,	371 29		802 22	
Sudbury and Cochituate aqueducts: —				
Labor,	13,411 46		33,318 64	
Supplies and expenses,	8,232 16		18,591 11	
Chestnut Hill Reservoir: —				
Labor,	9,436 68		26,212 94	
Supplies and expenses,	950 73		3,934 70	
Biological laboratory: —				
Labor,	2,597 47		8,021 78	
Supplies and expenses,	840 66	81,656 81	2,667 96	206,057 07
Distribution department: —				
Superintendence: —				
Services,	$5,703 09		$12,279 69	
Supplies and expenses,	1,266 64		2,606 35	
Arlington pumping station, pumping service: —				
Labor,	2,003 67		2,003 67	
Fuel,	945 50		945 50	
Repairs and supplies,	417 54		417 54	
Chelsea pumping station, pumping service: —				
Labor,	1,574 30		5,688 75	
Fuel,	1,088 11		4,674 34	
Repairs and supplies,	473 12		2,573 05	
Amounts carried forward,	$13,471 97	$2,179,785 67	$31,188 89	$20,316,855 18

EXPENDITURES FOR DIFFERENT WORKS.	For the Year ending December 31, 1900.		From Beginning of Work, and ending December 31, 1900.	
Amounts brought forward,	$13,471 97	$2,179,785 67	$31,188 89	$20,316,855 18
Maintenance and Operation — Con.				
Distribution department — *Con.*				
Chestnut Hill high-service pumping station, pumping service: —				
Labor,	18,998 92		65,587 55	
Fuel,	20,417 27		53,756 42	
Repairs,	6,837 79		10,545 09	
Oil, waste and packing,	921 42		2,452 97	
Small supplies,	1,080 12		2,820 78	
Chestnut Hill low-service pumping station, pumping service: —				
Labor,	7,499 38		7,499 38	
Fuel,	11,118 15		11,118 15	
Repairs,	62 09		62 09	
Oil, waste and packing,	487 23		487 23	
Small supplies,	361 52		361 52	
East Boston pumping station, pumping service: —				
Labor,	118 29		118 29	
Fuel,	86 25		86 25	
Repairs and supplies,	1 25		1 25	
Everett pumping station, pumping service: —				
Labor,	93 00		832 25	
Fuel,	-		340 24	
Repairs and supplies,	17 08		91 81	
Malden pumping station, pumping service: —				
Labor,	1,903 74		6,834 48	
Fuel,	2,994 65		9,130 69	
Repairs and supplies,	309 41		1,304 01	
Medford pumping station, pumping service: —				
Labor,	784 01		2,618 76	
Fuel,	825 50		1,635 90	
Repairs and supplies,	79 84		413 02	
Melrose pumping station, pumping service: —				
Labor,	-		2,364 60	
Fuel,	-		2,317 48	
Repairs and supplies,	-		673 56	
Revere pumping station, pumping service: —				
Labor,	-		559 60	
Repairs,	-		57 02	
Fuel,	-		481 86	
Somerville pumping station, pumping service: —				
Labor,	1,689 93		4,338 84	
Fuel,	1,893 75		4,514 83	
Repairs and supplies,	164 64		597 03	
Spot Pond pumping station, pumping service: —				
Labor,	4,353 72		4,353 72	
Amounts carried forward,	$96,070 92	$2,179,785 67	$229,545 46	$20,316,855 18

EXPENDITURES FOR DIFFERENT WORKS.	For the Year ending December 31, 1900.		From Beginning of Work, and ending December 31, 1900.	
Amounts brought forward, . . .	$96,070 92	$2,179,785 67	$229,545 46	$20,316,855 18
Maintenance and Operation — Con.				
Distribution department — *Con.*				
Spot Pond pumping station, etc. — *Con.*				
Fuel, ...	8,481 42		8,481 42	
Repairs, ...	43 97		48 97	
Oil, waste and packing, ...	348 37		348 37	
Small supplies, ...	464 10		464 10	
West Roxbury pumping station, pumping service: —				
Labor, ...	2,638 30		5,242 64	
Fuel, ...	1,895 71		3,113 42	
Repairs and supplies, ...	188 05		268 33	
Rent, ...	920 00		920 00	
Arlington standpipe, ...	153 96		274 22	
Fells Reservoir: —				
Labor, ...	998 07		1,162 57	
Supplies, ...	179 19		200 19	
Mystic Lake, conduit and pumping station: —				
Labor, ...	2,246 48		8,447 26	
Supplies and expenses, ...	585 38		3,112 21	
Mystic Reservoir: —				
Labor, ...	2,111 27		5,591 93	
Supplies and expenses, ...	357 16		2,019 56	
Spot Pond: —				
Labor, ...	2,786 35		3,949 02	
Supplies and expenses, ...	409 24		906 66	
Waban Hill Reservoir: —				
Labor, ...	890 50		890 50	
Supplies and expenses, ...	10 72		10 72	
Pipe lines: —				
Low service, labor, ...	4,036 86		21,246 19	
supplies and expenses, .	8,113 28		15,874 29	
tunnel, Mystic River, . .	12,048 50		12,048 50	
Chelsea Creek pipe line, .	14,437 52		14,437 52	
Northern high service, labor, . . .	1,955 27		3,533 77	
supplies and expenses, .	4,619 06		9,635 41	
Southern high service, labor, . . .	3,184 69		6,145 01	
supplies and expenses, .	402 18		1,335 03	
Buildings at Chestnut Hill: —				
Labor, ...	578 53		2,135 61	
Supplies and expenses, ...	275 91		575 14	
Glenwood pipe yard and buildings: —				
Labor, ...	2,547 66		4,195 89	
Supplies, ...	660 16		1,162 43	
Stables: —				
Labor, ...	3,397 93		6,090 55	
Horses, ...	450 00		450 00	
Vehicles, harnesses and fittings, . .	380 17		731 30	
Subsistence, ...	746 21		1,192 12	
Miscellaneous supplies, ...	615 24	180,228 28	1,238 98	377,015 29
Total for constructing, acquiring and maintaining works, ...	. .	$2,360,008 95		$20,693,870 47

(*b*) *Receipts.*

The total amount of receipts from rents, sales of property, etc., for the year beginning January 1, 1900, and ending December 31, 1900, is $30,051.84; and the total amount from the time of the organization of the Board, July 19, 1895, to December 31, 1900, is $138,386.37. The general character of these receipts is as follows: —

	For the Year ending December 31, 1900.	From Beginning of Work, and ending December 31, 1900.
Forfeiture for contracts awarded but not executed,	-	$500 00
Rents from real estate, ...	$15,721 56	43,571 63.
Sales of real estate and buildings, . . .	938 65	5,492 91
Land products, ...	2,670 89	9,601 28
Labor, tools and supplies, ...	8,389 40	15,923 73
Payments on account of admission into the Metropolitan Water District, ...	-	35,005 00
Payments on account of supplying water to towns outside of District, ...	2,000 00	22,645 84
Water furnished to water companies, . . .	291 20	5,371 58
Unclassified receipts, ...	40 14	274 40
Totals, ...	$30,051 84	$138,386 37

The foregoing receipts have been credited to the various objects or works, as follows: —

	For the Year ending December 31, 1900.	From Beginning of Work, and ending December 31, 1900.
Admission into Metropolitan Water District (Nahant, Quincy and Arlington), ...	-	$35,005 00
Supplying water to towns outside of Water District (Swampscott), ...	$2,000 00	22,645 84
Water furnished to water companies, . . .	291 20	5,371 58
Construction and acquisition of works: —		
Wachusett Dam, ...	55 09	55 09
Wachusett Reservoir, ...	17,679 16	48,395 49
Wachusett Aqueduct, ...	-	271 12
Sudbury Reservoir and watershed, . . .	257 00	6,522 00
Distribution system, ...	3,132 33	9,423 32
Diversion of water, Clinton sewerage system,	375 15	646 91
Purchase of existing water works, . . .	4,492 25	4,492 25
Maintenance and operation of works: —		
Wachusett Aqueduct, ...	497 24	1,147 11
Sudbury system, ...	792 95	3,116 62
Distribution system, ...	283 41	1,097 98
Clinton sewerage system, ...	196 06	196 06
Total receipts, ...	$30,051 84	$138,386 37

(*c*) *Assets.*

The following is an abstract of the assets, the more important items being given: —

Office Furniture, Fixtures and Supplies.

Book cases,	39	Reference books,	540
Plan cases,	43	Stools,	148
Miscellaneous cases and cabinets,	81	Coal stoves,	63
Chairs,	355	Tables, office,	77
Desks,	127	Tables, drafting,	42
Letter-copying presses,	23	Telephones,	19
Numbering machines,	5	Typewriters,	17
Railroad tickets, value,	$1,914 13	Stamped envelopes, value,	$695 00

Engineering and Scientific Instruments and Supplies.

Biological laboratory outfit,	1	Planimeters,	22
Chemical laboratory outfit,	1	Levelling, measuring and sight rods,	183
Drawing boards,	112		
Calculating instruments,	6	Rubber boots, pair,	237
Cement-testing machines,	6	Scales,	269
Current meters,	3	Section liners,	4
Electrical instruments,	4	Straight-edges,	73
Engineers' levels,	28	Tapes,	222
Pantographs,	3	Transverse testing machines,	4
Photographic outfit,	1	Transits,	30

Police Supplies.

Belts,	23	Handcuffs, pair,	30
Cells,	6	Revolvers,	7
Clubs,	32	Twisters, pair,	29
Beds,	13	Stretchers,	2

Horses, Vehicles, Field Machinery, etc.

Horses,	19	Carts,	9
Carriages,	8	Sleds,	6

Horses, Vehicles, Field Machinery, etc. — Concluded.

Sleighs,	14	Blankets,	46
Wagons,	15	Harnesses,	32
Harrows,	3	Robes,	23
Mowing machines,	3	Busk hooks, bill hooks, scythes, etc.,	288
Ploughs,	12	Hand carts,	6
Horse rakes,	3	Border knives, hedge trimmers, etc.,	32
Road rollers,	5	Lawn mowers,	12
Road scrapers,	2		
Tedders,	2		

Machinery, Tools and Other Appliances and Supplies.

Adzes,	5	Grindstones,	30
Anchors,	20	Hoes, all kinds,	172
Anvils,	13	Forks,	133
Axes and hatchets,	170	Hammers,	409
Barrows,	122	Heaters,	1
Bars, crow and others,	203	Hoisting buckets,	39
Blasting battery,	2	Hose, all sizes, feet,	5,381
Blocks, all kinds,	197	Ice tools,	144
Blowers,	2	Indicators,	9
Boats, row,	17	Injectors and inspirators,	10
Boilers,	27	Jacks,	60
Diamond drills,	2	Ladders, feet,	1,040
Diamonds for same, K,	$74\frac{1}{32}$	Lathes,	4
Chisels,	371	Lumber, M feet B. M.,	313.7
Carts and cars,	13	Mattocks,	204
Chain hoists,	28	Mauls,	23
Concrete mixer,	1	Meters, pressure, etc.,	17
Derricks,	15	Motors,	2
Dredges, scows, etc.,	9	Oil cabinets and tanks,	34
Drilling machines,	24	Pile drivers,	3
Dynamos,	5	Pipe cutters,	21
Engines,	26	Die plates, stocks, etc.,	40
Forges,	7	Pipe-tapping machine,	1
Furnaces, melting,	6	Picks,	359
Gages,	91	Planer,	1

Machinery, Tools and Other Appliances and Supplies — Concluded.

Plumber's furnace,	1
Pumping engines,	9
Pumps, steam,	49
Pumps, centrifugal,	13
Pumps, diaphragm,	16
Pumps, miscellaneous,	19
Rakes,	247
Rammers,	106
Rock drills,	2
Saws,	132
Scales, yard, platform, etc.,	33
Settees, Chestnut Hill grounds,	44
Shovels, scoops, spades, etc.,	1,058
Shovel, steam,	1
Stone crusher,	1
Temporary buildings and structures,	70
Tongs,	124
Tool and coal boxes, etc.,	47
Trench and other braces,	28
Trucks,	3
Vises,	42
Winches,	2
Wrenches,	798
Wrought-iron pipe, all sizes, feet,	11,442
Cast-iron pipe, miscellaneous lots, tons,	153
Cast-iron pipes, special castings, valves, man-hole frames and covers, etc., at pipe yards, estimated value,	$119,210 54

Real estate connected with works not completed: —

Real estate in the site of the proposed Wachusett Reservoir and margins; outlying property in Clinton, Boylston, West Boylston, and Sterling; land for Weston Aqueduct and Reservoir; and reservoir and standpipe on Forbes Hill, Quincy.

Completed works, including real estate connected therewith: —

Wachusett Aqueduct, Sudbury Aqueduct, Cochituate Aqueduct; Whitehall Reservoir, Hopkinton Reservoir, Ashland Reservoir, Framingham Reservoirs Nos. 1, 2 and 3, Sudbury Reservoir, Lake Cochituate, Chestnut Hill Reservoir, Waban Hill Reservoir, Fells Reservoir; Mystic Lake, conduit and pumping station (not used); Mystic Reservoir; Arlington standpipe; Chestnut Hill high-service pumping station; Chestnut Hill low-service pumping station; Spot Pond, with pumping station building; temporary pumping station, Arlington; sewerage system and pumping station, Clinton; 69.82 miles of pipe line in distribution system; Mystic yard and buildings; Glenwood yard and buildings; Clinton office and grounds.

(*d*) *Liabilities.*

There are liabilities as follows: —

Unpaid bills,	$11,000 00
Due on monthly pay rolls,	5,100 00
	$16,100 00*

Amounts reserved on Monthly Estimates, not due until Completion of Contracts or until Claims are settled.

NAME.	Work.	Amount.
Silvio Casparis,	Wachusett Aqueduct, Sect. 5,	$600 00
Silvio Casparis,	Wachusett Aqueduct, Sect. 6,	700 00
Auguste Saucier,	Marlborough Brook filter-beds,	3,227 50
McArthur Brothers Company,	Wachusett Dam,	450 12
Busch Brothers,	Building road, Wachusett Reservoir,	600 00
Moulton & O'Mahoney,	Wachusett Reservoir, Sect. 4,	5,704 10
Nawn & Brock,	Wachusett Reservoir, Sect. 6,	59,000 00
Long & Little,	Wachusett Reservoir, Sect. 7,	10,779 16
Fred E. Ellis,	Shrewsbury Road, Sect. 2,	200 00
Norcross Brothers,	Chestnut Hill low-service pumping station,	4,361 42
McNeil Brothers,	High-service pumping station, Items 1 to 7,	101 77
John S. Jacobs & Son,	Gate-house, Chestnut Hill Reservoir,	1,400 00
Beckwith & Quackenbush,	Reservoir and foundation for standpipe,	2,209 07
Charles A. Haskin,	Tunnel under Mystic River,	1,936 50
		$91,269 64

Amounts have been agreed upon in the following cases, but the deeds have not passed: Bruno St. Onge, $4,000; Arthur W. Woods *et als.*, $2,500; city of Boston, $7,531,000, balance, and interest.

On the claims of the following, it is impossible to state the amounts due for land damages mentioned above, the same not having been liquidated, but being still subject to negotiation or adjudication: Margaret F. Tonry, heirs Thomas Prendergast, Margaret

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* Miscellaneous current bills of 1900, including those coming in from time to time after January 1, have since been paid.

Cain, Bridget Padden, Patrick T. Moran, Harriet Wilder, James H. Woods, Lawrence Downey, Thomas Cain, heirs of Thomas H. O'Conner, Charles E. Smith, G. C. Hudson, R. P. Boynton, John N. Whittemore, Mary Williams Swinscoe, Maria A. Haskell, Timothy John Fahy, Chloe Ann Ballou, William H. Buck, George E. Walker, estate of Henrietta M. Johnson, Charles L. Johnson, Israel G. Howe, Charles B. Sawin, Eben S. and W. A. Fuller, W. O. Johnson, heirs Owen Kittredge, Timothy J. and Mary A. Lynch, James H. Moulton heirs, Ashley Wood *et als.*, Jeremiah Potter, J. R. Stott, Horace H. Lowe, Helen Spencer, Christian Schmidt, Sarah A. Laythe, G. A. Heighway, Arthur W. Woods *et als.*, Bigelow Carpet Company, Clinton Worsted Company, Cornelius J. Mack *et als.*, Arthur J. Bigelow, Hervey A. Gilmore *et als.*, Levi A. Bathrick heirs, Elijah Bemis, Charles E. Nichols, Nellie E. Burke, Catherine McGuinness, Edward Garrity *et al.*, John A. Frye, J. M. Sears, city of Malden, balance, city of Medford, city of Melrose, town of Boylston, town of Southborough, town of West Boylston, James B. Marsh, Henry Jackson, Helen C. Harlow, Antoine Snow, Sarah E. Kirby, John McQuillan, Louis Langway, Emory A. Bacon, George H. Holmes, Edward A. Cowee, Almira F. Rice, Frances A. Wilder, Frances A. Wilder and Candace Chace, Abigail Valley, Joseph Toombs, Mary F. H. Cutting, Cyrus Colt, Ellen S. Warren, heirs of Hanson Chase, Boston & Maine Railroad, American Telephone and Telegraph Company, Margaret Lane, John N. Flagg, heirs of Stephen Holt, George L. Hyde, Edward A. Harper, Thomas Mackesy, Delina Mallett, Independent Order of Odd Fellows, John F. O'Brien, David P. Waite.

Of the above-named claims, those of the heirs of Thomas Prendergast, Lawrence Downey, Eben S. and W. A. Fuller, Ashley Wood *et als.*, and heirs of James H. Moulton, are barred by the limitation in the statute, they having failed to bring suit within the limit of two years.

VI. ADDITIONAL METROPOLITAN WATER LOAN.

The necessities for proceeding at once upon the building of the new Weston Aqueduct and for paying the amount determined to be due to the city of Boston on account of the taking of its works of water supply will require an additional Metropolitan Water Loan, in order to provide for the additional expenditures which will be called for.

The State Board of Health, in its report to the Legislature in the year 1895, recommending a scheme for Metropolitan Water Works, estimated that the cost of the works recommended would amount to $19,045,800. The Metropolitan Water Act, as passed, however, required the Board not only to carry out the scheme as recommended by the State Board of Health, but also required the Board to assume and complete the construction of the Sudbury Reservoir, which had been begun by the city of Boston, and to take the main works of water supply of that city and of the cities of Malden, Medford and Melrose at Spot Pond. No further estimate was presented as to the additional amount which would thus be required, either for the Sudbury Reservoir, or for the main works of water supply of the city of Boston, or the works at Spot Pond; but the Legislature authorized the issue of bonds for the payment of the operations of the Board, from time to time as might be required, to an amount not exceeding a lump sum of $27,000,000.

The Board has gone on, and has not only proceeded to construct the works embraced in the original scheme, but has finished the Sudbury Reservoir and taken the other works, as required, from the city of Boston and from the cities of Malden, Medford and Melrose. It believes that the works which are embraced in the original scheme will be completed within the sum of $19,045,800, estimated by the State Board of Health, as it has thus far kept within the original estimates. The Board has in addition expended for reimbursement to the city of Boston and for completion of the Sudbury Reservoir $2,920,109.46. It has paid on account to the city of Boston for the works taken on January 1, 1898, the sum of $5,000,000. The payments and requirements for carrying out the original scheme, and the payments made for the Sudbury Reservoir, and on account to the city of Boston, will thus absorb substantially all of the $27,000,000 already appropriated.

It has become necessary, as has been shown, to begin at once the construction of an additional aqueduct, to convey the water from the Sudbury River to the Metropolitan District. The State Board of Health declared in the year 1895 that an aqueduct would thus be required within a period of ten years from that date, and estimated the cost at $4,982,000; but, though such an aqueduct was involved in the ultimate completion of the works, no appropriation was recommended at the time by the State Board of Health or was made in the Act for this purpose.

The sum of $7,531,000, together with interest from November 1, 1900, is determined by the court as the amount to be paid in settlement to the city of Boston.

The sums to be paid to the cities of Malden, Medford and Melrose, on account of the taking of Spot Pond and the adjoining lands, were, like the sum to be paid to the city of Boston for its water works, not included in the original estimates of the State Board of Health. The amount necessary to be paid these cities has not yet been determined.

A deficiency somewhat exceeding $200,000 has already arisen, by reason, as hereafter explained, of the present annual assessments being inadequate to meet the current annual charges.

It will, therefore, be necessary for these purposes to provide for an additional Metropolitan Water Loan of about $13,000,000.

A further considerable sum, in addition, will be required unless a change is made in the present provisions of the Metropolitan Water Act. The Act provided that the assessments imposed upon the cities and towns in the District, in order to meet the cost of maintenance, interest on the loan and the requirements of the sinking fund, should not begin until the year 1898, and that $300,000 should be assessed for that year, to which $42,500 was added on account of the preliminary expenditures of the State Board of Health. An increase of $200,000 is made in each successive year until the total assessments are sufficient to meet the total requirements. The earlier assessments are inadequate to meet the annual requirements, so that the deficiency arising in the first eight or ten years will have to be made up by increasing the ultimate total indebtedness or loan. Under the Act, as it stands, the total of the assessments for the District for the year 1901 will be $900,000. On the other hand, the sum necessary to meet all the year's requirements will, as estimated, amount to $1,534,800. To meet these successive deficiencies, it is estimated that the amount of the loan ultimately necessary will have to be further increased by at least $4,000,000.

The Board believes that it would be much wiser for the District to obtain legislation by which the amount of the annual assessments upon the cities and towns shall be made sufficient to meet the annual requirements for maintenance, interest and the sinking fund, and thus avoid deficiencies which will have to be provided for by an increased loan.

The necessity of providing for an additional loan of $13,000,000 or $17,000,000, as the case may be, does not arise because the carrying out of the work exceeds the original estimates, or because the cost of the work is to be greater than was originally anticipated. The building of the Weston Aqueduct was a part of the original scheme which the Board was directed to carry out, but no provision for its construction was made in the amount of loan at first authorized, such provision being left to be made when the building of the aqueduct should become necessary. The Board was required to take the works of water supply of the city of Boston, but no estimate of the amount necessary to be paid for them was attempted, and this amount has now been fixed under proceedings in court. The Metropolitan Water Act failed to make annual assessments upon the cities and towns in the District adequate to meet the current expenditures required, and so an ultimate deficiency must result unless the Act is amended.

Whatever may be the total amount of indebtedness incurred for the construction of the Metropolitan Water Works, that amount is to be borne, not by the Commonwealth, but by the Metropolitan Water District, and, as it would seem from the results already obtained, the annual burdens laid upon the water takers in the District will not be increased, but, on the other hand, will be materially lessened by the building and operation of the Metropolitan Water Works.

VII. WORK ACCOMPLISHED AND FOR THE FUTURE.

Since its organization in the year 1895, the Metropolitan Water Board has taken, as a new source of water supply, the waters of the South Branch of the Nashua River, and, by the building of the Wachusett Aqueduct, the completion of the Sudbury Reservoir and the taking of the works of water supply of the city of Boston, has connected this new supply with the Metropolitan Water District; the capacity of the water works of the District, exclusive of supplies of inferior quality, which have been discontinued, has been increased from 48,000,000 gallons per day to 110,000,000 gallons per day. The capacity of the storage reservoirs has been increased from

8,605,000,000 gallons to 15,858,500,000 gallons. The distributing reservoirs, which not only equalize the flow from aqueducts and pumps, but also contain, close at hand, a very considerable supply for use in cases of emergency or accident, have been increased from a capacity of 393,000,000 gallons, or, including Spot Pond, which was available to only three of the smaller places, from 1,150,000,000 gallons, to a capacity of 2,178,680,000 gallons; the pumping capacities of the District have been increased from 97,000,000 gallons per day to 204,000,000 gallons per day; the water is delivered with an increased pressure in nearly all parts of the District, and an entirely new system of distribution has been constructed for the delivery of the water to the various cities and towns of the District, involving the laying of about seventy miles of main pipes.

By the introduction of the better water from the Nashua River and the increase of storage capacity, so that the water can stand longer for sedimentation and bleaching, the discontinuing of polluted sources, the drainage of swamps, the building of filter-beds and the suppression of many minor sources of pollution, the quality of the water afforded has been greatly improved.

The sum of $10,403,682.06 has been expended in the construction of new works, the sum of $3,521,576.76 has been paid in settlement for real estate taken and acquired, the sum of $113,528.58 has been paid in settlement of damages to real estate not taken and to business interests, the sum of $898,157.25 has been paid on account of the diversion of water, and the sum of $5,090,472.19 has been paid toward the purchase of existing water works. The total sum already expended by the Board, exclusive of maintenance, amounts to $20,027,416.84.

According to the estimates originally made by the State Board of Health, which it is believed will not be exceeded, the cost of carrying out to completion the scheme recommended by that Board, including the construction of the Weston Aqueduct, will be $24,027,800; the total cost of constructing the Metropolitan Water Works in accordance with the terms of the Metropolitan Water Act, including the sums paid and to be paid the city of Boston, will amount to about $40,000,000.

The entire amount required for the construction of the Metropolitan Water Works will be paid by the Metropolitan Water District. There is no probability, however, that the financial burdens of the various cities and towns will be increased, but, on the other hand, it is believed that the assessments required will be less than would have been called for if each city and town had continued to depend upon the existing water works with the enlargements which would have been required from time to time. The benefits of combined action, both in construction and maintenance, have already been felt, but will be more appreciable in the future.

The old Sudbury basins or reservoirs, built by the city of Boston, cost, upon the average, $616 per million gallons capacity; the new Sudbury Reservoir cost $403 per million gallons capacity; the Wachusett Reservoir will, as is estimated, cost $144 per million gallons capacity.

The Cochituate Aqueduct cost $4,921 per million gallons capacity per mile; the Sudbury Aqueduct cost $2,069 per million gallons capacity per mile; the Wachusett Aqueduct cost $494 per million gallons capacity per mile. The expenditures for the smaller works of the various cities and towns far exceeded in proportion the cost of the larger works of the city of Boston.

In the year 1897, before the operation of the water works by the Board, there were seventeen pumping stations in the District, two of them being the large pumping stations of the city of Boston. Now all of the water, except a very small quantity supplied by the West Roxbury and Arlington pumping stations, is pumped at the two large pumping stations at Chestnut Hill and at the pumping station at Spot Pond. The average cost of pumping per million gallons in the year 1897 was $9.94. The average cost of pumping per million gallons by the Metropolitan Works in the year 1900 was $3.34.

Since the supply of water has been furnished by the Metropolitan Water Works no municipality has been obliged to increase its water rates, but, on the other hand, in some the rates have been reduced, and in others the surpluses from water revenue have been applied to the payment of the extension of works or to other public uses, or charges for water supplied for public purposes have been abolished. All the statistics so far obtained by the Board indicate that water rates, instead of being increased, may in the future rather be reduced in the Metropolitan District.

The building of the Wachusett Dam, which is but just begun, and of the Wachusett Reservoir, which is about one-third completed, and the construction of the Weston Aqueduct, in order to bring the increased supply to the Metropolitan District, are the larger works which are to be prosecuted in the future. Additional sections of main pipe lines must be laid; systems of sewers and of swamp drainage, and other works for the prevention of pollution, must be carried out; and some additional works will be required, as additional cities and towns are admitted into the District.

The completion of these works will, as is estimated, require the expenditure of about $12,125,000, and will occupy a probable further term of four or five years.

In return for the expenditure of these large sums, the Metropolitan Water District will have sources of supply of an estimated capacity for supplying 173,000,000 gallons of water per day, or, at the present rate of consumption per capita, a population of about 1,500,000; storage reservoirs with a capacity of holding nearly 80,000,000,000 gallons; aqueducts capable of carrying for the present supply and for the future additions 420,000,000 gallons per day; reservoirs at different points in the District holding for immediate use and security 2,200,000,000 gallons; and pumping facilities, pipe line connections and other means for supplying the larger water supply to every portion of the Metropolitan Water District.

In order that the larger supply shall be adequate for a considerable period of years, and resort to the further sources of supply contemplated for the future shall be deferred, and that there may be an increased lessening of the burdens of the water takers, the various portions of the District should unite in all proper and reasonable measures for the prevention of the excessive use and waste of water.

The report of the Chief Engineer is herewith submitted.

Respectfully submitted,

HENRY H. SPRAGUE.
WILMOT R. EVANS.
HENRY P. WALCOTT.

BOSTON, January 1, 1901.

REPORT OF THE CHIEF ENGINEER.

To the Metropolitan Water Board.

GENTLEMEN: — The following is a report of the operations of the engineering department for the year ending December 31, 1900.

ORGANIZATION.

The general organization of the Engineering Department remains the same as last year, except that a new department was established September 24 for the construction of the Weston Aqueduct, with Horace Ropes as department engineer.

The list of engineers reporting directly to the chief engineer is as follows: —

Dexter Brackett, .	*Engineer, Distribution Department.*
Desmond FitzGerald,	*Engineer, Sudbury Department.*
Thomas F. Richardson,	*Engineer, Dam and Aqueduct Department.*
Hiram A. Miller,	*Engineer, Reservoir Department.*
Horace Ropes, .	*Engineer, Weston Aqueduct Department.*
Alfred D. Flinn,	*Principal Office Assistant.*
John N. Ferguson, .	*Office Assistant.*

Joseph P. Davis, A. Fteley and Hiram F. Mills have continued to act as consulting engineers.

Will J. Sando resigned the position of superintendent of pumping stations on August 31, in order to accept a position as manager of the water works department of the International Steam Pump Company.

At the beginning of the year the engineering force, including both those engaged upon the construction and maintenance of the works, numbered 183, and gradually diminished until March 10, when it numbered 171, then increased with the increasing amount of work until June 30, when it reached a maximum of 193, and at the end of the year had decreased to 159.

In addition to the engineering force, which included the engineers engaged upon the inspection of the work, other inspectors have been employed upon earthwork, masonry, machinery and pipe laying. The maximum number so employed at any one time during the year was 8.

Gangs of men under the immediate direction of foremen, and under the general direction of the engineers, have been employed to drive sheet piling at the north dike of the Wachusett Reservoir, upon excavations and preliminary work at the Wachusett Dam, to dig drainage ditches in swamps, to make changes in and additions to the Marlborough Brook filter-beds, to lay pipes in the Metropolitan Water District, and to do other minor work. There has also been a maintenance force, averaging 145, employed at the pumping stations and in connection with the maintenance of reservoirs, aqueducts, pipe lines and other works.

Force employed on Works.

The largest force employed upon the works at any one time during the year was in the latter part of June, as follows: —

	Men.		Horses.	
Contractors' force: —				
Reservoir Department,	1,379		281	
Distribution Department,	527	1,906	151	432
Day-labor force, construction,		230		14
Engineering force, including engineer inspectors and those engaged upon maintenance,		193		-
Inspectors not engineers,		7		-
Maintenance force, not including civil engineers,		141		
		2,477		446

CONSTRUCTION.

CONTRACTS.

A detailed statement of the contracts made and pending during the year is given in Appendix No. 1. The following statement gives a summary of all the formal contracts charged to construction from the beginning of the work to the end of 1900: —

PORTION OF WORK.	Number of Contracts.	Approximate Amount.
Wachusett Reservoir,	23	$1,869,973 26
Wachusett Aqueduct and Clinton sewerage,	20	1,516,259 67
Wachusett Dam,	2	1,622,755 00
Sudbury Reservoir, contracts assumed from the city of Boston (uncompleted portions),	11	583,220 54
Sudbury Department, reservoir, filter-beds and pipe lines, contracts made by Metropolitan Water Board,	20	895,850 72
Distribution Department, including pipes purchased for other departments,	130	3,538,693 05
Totals,	206	$10,026,752 24

Number of contracts made and assumed in 1896,	56
Number of contracts made in 1897,	53
Number of contracts made in 1898,	40
Number of contracts made in 1899,	44
Number of contracts made in 1900,	13
	206

Amount of contracts made and assumed in 1896, including only the uncompleted portions of contracts assumed from the city of Boston,	$3,893,934 31
Amount of contracts made in 1897 (approximate),	1,257,676 02
Amount of contracts made in 1898 (approximate),	729,253 03
Amount of contracts made in 1899 (approximate),	2,397,230 39
Amount of contracts made in 1900 (approximate),	1,748,658 49
	$10,026,752 24

Number of contracts completed in 1896,	13
Number of contracts completed in 1897,	57
Number of contracts completed in 1898,	57
Number of contracts completed in 1899,	37
Number of contracts completed in 1900,	30
Number of contracts uncompleted December 31, 1900,	12
	206

Amount of contracts completed in 1896,	$651,449 77
Amount of contracts completed in 1897,	3,013,206 37
Amount of contracts completed in 1898,	1,435,228 08
Amount of contracts completed in 1899,	983,218 37
Amount of contracts completed in 1900,	779,889 08
	$6,862,991 67
Amount of contracts uncompleted December 31, 1900 (approximate),	3,675,760 57
	$10,538,752 24
Deduct for work done on 11 Sudbury Reservoir contracts by city of Boston,	512,000 00
	$10,026,752 24

Value of work done by contract to December 31, 1896,	$2,061,910 38
Value of work done by contract from January 1, 1897, to December 31, 1897,	2,647,063 53
Value of work done by contract from January 1, 1898, to December 31, 1898,	703,141 71
Value of work done by contract from January 1, 1899, to December 31, 1899,	1,206,791 72
Value of work done by contract from January 1, 1900, to December 31, 1900,	927,034 80
	$7,545,942 14
Value of work remaining to be done on uncompleted contracts December 31, 1900 (approximate),	2,480,810 10
	$10,026,752 24

In the case of all contracts completed up to the present time final settlements have been made without any legal controversy.

RESERVOIR DEPARTMENT.

HIRAM A. MILLER, *Department Engineer.*

The organization of the engineering staff has been somewhat modified during the year, and the force has been increased. Alexander E. Kastl, division engineer, has continued in charge of the work at the North Dike, including that being prosecuted by day labor as well as the contract work. Charles E. Wells, division engineer, has continued in charge of the inspection of the removal of soil from the Wachusett Reservoir and the supervision of the contractors engaged in that work. On account of the large increase in the work of removal of soil, Charles A. Bowman, division engineer, has been relieved of charge of road construction, and his time has been mainly confined to his duties in charge of the force reports, measurements, estimates and other engineering work connected with the removal of soil, other than the inspection and the supervision of the contractors, and of the final records of the department. For a large portion of the year assistant engineers Harry J. Morrison and Moses J. Look have reported directly to the department engineer. They have been in charge of road construction, preliminary investigations and miscellaneous engineering work.

The total engineering force in this department has varied from 56 to 86. In addition to this force, a portion of the drafting work has been done by employés of the Dam and Aqueduct Department, increasing the total force employed by an average of 1.

The main office of this department has been continued in the building constructed by the Board for an engineers' office at the corner of Walnut and Prospect streets, in Clinton. The branch office on Boylston Street, in Clinton, was discontinued January 1. The other three branch offices, one near the North Dike, in Clinton, one at Sawyer's Mills, in Boylston, and the other at West Boylston, have been continued throughout the year.

NORTH DIKE.

Work upon the North Dike has been in progress during the year under the following contractors: —

Moulton & O'Mahoney,	Contract 150.
Cenedella Brothers,	Contract 160.
Nawn & Brock,	Contract 166.
Long & Little,	Contract 183.
Martin Murphy,	Contract 186.
Newell & Snowling Construction Company,	Contract 197.

The work done by each will be described more fully under the head of contracts. The total amount of work done during the year, and in previous years, with the total amount to date, is given in the following table: —

	To December 31, 1899.	For the Year 1900.	Total to December 31, 1900.
Soil and earth excavated from main cut-off (cubic yards),	468,799	31,057	499,856
Soil and earth excavated from secondary cut-off (cubic yards),	42,033	–	42,033
Sheet piling driven (linear feet),	3,798	1,447	5,245
Surface of rock uncovered and treated at bottom of main cut-off (square feet),	63,700	13,550	77,250
Soil from reservoir deposited in cut-off trenches and in the dike (cubic yards),	437,800	1,672,555	2,110,355
Earth and gravel taken from the borrow pits and deposited in the dike (cubic yards),	24,220	18,505	42,725
Earth excavation for the construction of a small dike in Coachlace Pond (cubic yards),	19,172	–	19,172
Drain pipe laid at toe of westerly portion of dike (linear feet),	7,083	–	7,083

The present condition of the dike relative to its completion is as follows: The excavation of the main cut-off trench, which has a width of 30 feet on the bottom, a maximum depth of 60 feet, and which extends longitudinally under the highest part of the dike for a total distance of 9,556 feet, has been completed. The sheet piling, which is driven in the bottom of the trench for a total length of 5,245 feet, has also been completed. The filling of the main cut-off trench with soil is far advanced, so that there will be but little more earth to excavate on account of the caving of the sides of the trench. The secondary cut-off trench and its filling with soil have been completed.

Of the soil filling, which is the largest feature of the dike, 2,110,354 cubic yards have been deposited, which is 38 per cent. of the amount required as at present estimated.

The embankment of sand and gravel on the water side of the dike is far advanced toward completion. The heavy stone facing of the embankment, to protect it against waves, has not yet been begun. The total length of the dike on the water side at full-reservoir level is 10,498 feet.

The contract work on the northerly slope of the easterly portion of the North Dike, from the toe up to elevation 355, has been completed by the contractor and accepted from him under the terms of the contract.

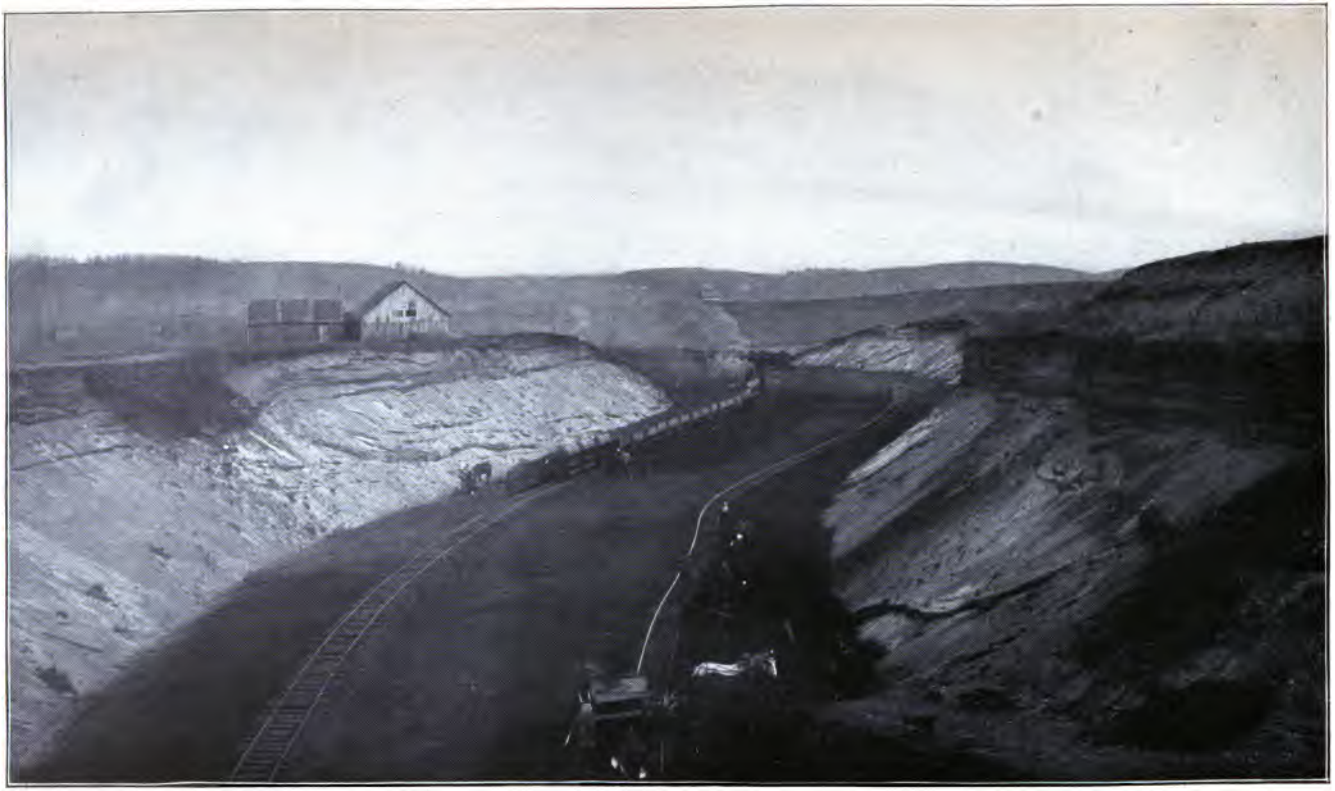
In addition to the contract work, the following work has been done at the North Dike by a day-labor force: —

The sheet piling work (described in detail on pages 81 and 82 of the last annual report) was continued. The greatest number of 6-inch sheeting piles driven in any one day was 28. These piles were 20¼ inches wide, 15 of them being 46 feet and 13 45½ feet long. The tops of the piles when driven were 5 feet above the bottom of the cut-off. On the easterly portion of the dike, 6-inch sheeting has been driven for 154 linear feet and 4-inch sheeting for 4 linear feet, making a total of 158 linear feet; on the westerly portion, 6-inch sheeting has been driven for 454 linear feet and 4-inch for 835 linear feet, making a total of 1,289 linear feet; the total for both portions, 1,447 linear feet. This, added to 3,798 linear feet (amount driven in 1899), makes the total length of completed sheeting 5,245 feet. The work was completed on May 29.

Where the trench was excavated to the rock, the surface of the rock was carefully washed off with a hose, using water under a considerable pressure; all seams were carefully cleaned out, and, if small, filled with Portland cement mortar, or, if large, with bricks laid in the mortar. Brick cut-off walls were built where needed, and the entire rock surface covered with two coats of grout, put on with whitewash brushes. At the westerly portion of the North Dike 13,550 square feet were treated in this way, which, added to the 63,700 feet previously treated, makes a total of 77,250 square feet.

During June a sluiceway was constructed across the small dike, in order to prevent any surface water from the main dike from overflowing the small one.

During the early part of the year some of the earth deposited within the cross-section of the dike was consolidated by saturating



WACHUSETT RESERVOIR—PORTION OF NORTH DIKE, SHOWING MAIN CUT-OFF TRENCH, PARTLY REFILLED WITH IMPERVIOUS SOIL.

it with water pumped from Coachlace Pond and from the main cut-off excavation on the west side of Coachlace Pond. During the latter part of the year the soil from the reservoir deposited in the large embankment in Coachlace Pond has been consolidated by saturation with water obtained by a connection with the Clinton Water Works.

The maximum day-labor force employed at the North Dike was 70 men and 7 horses, for the week ending January 6, 1900.

Cross-sections have been made of the entire dike where soil has been deposited, and an estimate made of its volume in embankment, for the purpose of determining the amount of shrinkage by comparing this volume with that obtained by measuring the soil in excavation.

RELOCATION AND CONSTRUCTION OF ROADS.

Considerable progress has been made on the construction of roads around the reservoir, to take the place of those discontinued and to be discontinued, between Clinton and West Boylston, and also between Boylston Centre and West Boylston. Some progress has also been made upon plans for the relocation of the roads in West Boylston between the villages of West Boylston and Oakdale.

New Road from West Boylston to Boylston, called the Shrewsbury Road.

The location and character of this road were determined by a decree of the Massachusetts Highway Commission, dated May 6, 1899. The work was completed, and was approved by them October 18, 1900.

At the commencement of the year the work of constructing this road to subgrade, from the junction of Temple and Pierce streets in West Boylston to the road in Boylston leading from Boylston Centre to Shrewsbury, a distance of 15,050 feet, was about two-thirds completed. During the year this work has been completed.

New contracts have also been made and completed for regrading Temple Street between Worcester and Pierce streets, an additional distance of 5,099 feet, and the entire road-bed for the whole distance of 20,149 feet has been surfaced with broken stone 15 feet wide and 6 inches thick.

The contractors on this work have been: —

Busch Brothers,	Contract 176.
Thomas H. Gill,	Contract 187.
T. Stuart & Son,	Contract 189.
Fred E. Ellis,	Contracts 190 and 191.

A description of the operations of each contractor is given under the head of contracts.

The principal items of work done by these contractors during the year have been: —

Earth excavation (cubic yards),	19,600
Rock excavation (cubic yards),	1,301
Slope paving (cubic yards),	4,373
Masonry (cubic yards),	304
Sewer and cast-iron pipe culverts (linear feet),	478
Sewer pipe side drains (linear feet),	1,358
Shaping surface of road-bed (linear feet),	20,149
Broken stone in place (tons, 2,000 pounds),	12,698

Of the earth excavation, 4,789 cubic yards represent soil from the reservoir, and 300 cubic yards of gravel were used to cover a muck hole. There was also $3,567 worth of extra work performed by the contractors, mainly in riprapping brook channels and repairing a culvert, one end of which has been undermined by the floods.

Embraced in the above summaries, also, is the rebuilding of a culvert washed out on the Worcester Road, in Boylston, a short distance toward Worcester, from where this road is crossed by the Shrewsbury Road.

The above quantities, added to the work performed during the previous year, make the total quantities of contract work upon the Shrewsbury Road, as follows: —

Earth excavation (cubic yards),	109,440
Rock excavation (cubic yards),	3,193
Slope paving (cubic yards),	4,863
Masonry (cubic yards),	836
Sewer and cast-iron pipe culverts (linear feet),	751
Sewer pipe side drains (linear feet),	1,358
Shaping surface of road-bed (linear feet),	20,149
Broken stone in place (tons, 2,000 pounds),	12,698

Of the earth excavation, 43,755 cubic yards represent soil from the reservoir and 300 cubic yards earth used to cover a muck hole. The total cost of the contract work in connection with this road was $77,003.73.

In addition to the above, 160 cubic yards of slope paving and 11,794 feet of guard fence, consisting of two spruce rails fastened to chestnut posts, have been built by a day force, making, with the 1,500 feet of similar guard fence constructed the previous year, a total of 13,294 feet. The day force also seeded the embankment slopes, cut the grass, and maintained the road from the time it was completed by the contractors until its construction was approved by the Massachusetts Highway Commission.

New Road from Clinton to Lancaster Street, West Boylston.

Two hundred and ninety-five linear feet of sewer pipe drains and one catch-basin were constructed at South Main Street in Clinton. That portion of the road between the South Meadow Road and Lancaster Street was maintained from the beginning of the year until the construction was approved by the county commissioners, on June 19, 1900.

Improvement of Lancaster Street, West Boylston.

A day force constructed an iron pipe culvert 60 feet long, with masonry head walls containing 5 cubic yards, and 177 square yards of cobble-stone gutters. This force also maintained the road until the construction was approved by the county commissioners, on June 19, 1900.

Temporary Bridge at West Boylston.

A day force built a temporary bridge on piles, with masonry abutments, over the Nashua River at Prospect Street in West Boylston, to take the place of the stone arch bridge which was destroyed by the flood of February. This bridge is 18 feet wide and 99 feet long. Six hundred cubic yards of stone, the wreckage of the old arched bridge, were removed from the bed of the river. There were 24,000 feet B.M. of spruce and hard pine lumber used in its construction, and 80 cubic yards of dry masonry laid in the abutments.

ENGINEERING AND MISCELLANEOUS WORK CONNECTED WITH ROADS.

Topographical surveys have been made of 123 acres. Plans showing the location of a new road on the northeast side of the reservoir from Lancaster Street to Pleasant Street in West Boylston, a distance of 6,346 feet, have been prepared, together with an estimate of the quantities required for the construction of this road.

In connection with the surveys and investigations for the proposed new highway crossing of the Wachusett Reservoir, between West and South Boylston, 89 test pits, averaging 6 feet in depth, have been dug to the rock surface, and a contour plan of the rock surface has been prepared. The new highway in the village of Oakdale cannot be definitely located until the relocation of the Central Massachusetts Railroad has been determined.

In addition to the engineering work connected with the construction of new roads, 4¾ miles of trial lines for new roads have been run and profiles of 5¼ miles have been made.

Record plans, on white paper, of all the roads which have been constructed (7 plans in all), have been made and filed with the various towns in which the roads have been constructed. A tracing of the Shrewsbury Road has also been filed with the county commissioners. Two plans for the discontinuance of roads have been made.

When Boylston Street was constructed, in 1898, a temporary culvert was built across River Street, to serve until the embankment should be thoroughly consolidated. During the present year this temporary culvert was replaced by a permanent 12-inch pipe culvert, by a day-labor force. This force has also set 43 stone monuments on the road locations, and has maintained lanterns at the ends of all discontinued roads for a period of six months after their discontinuance. Frequent repairs have been made by Nawn & Brock, as extra work under Contract 166, on roads leading from South Clinton and from Sawyer's Mills to Boylston Centre, such repairs being required on account of the operations connected with the stripping of soil from the reservoir. The maximum day-labor force employed in connection with the relocation of roads was 55 men and 15 horses for the week ending May 5, 1900.

REMOVAL OF SOIL.

Only one small contract has been made for the removal of soil during the year. The engineering and other work preliminary to letting additional contracts has, however, been continued. For the guidance of the inspectors, the organic matter in 702 samples of soil has been determined, as well as the rate of filtration through 39 samples.

The total amount of soil removed and to be removed from the Wachusett Reservoir is at present estimated to be some 6,600,000 cubic yards from approximately 4,200 acres; of this the total amount removed in previous years, not including that removed from the pond of the Lancaster Mills, which was temporarily deposited along the margins of the mill pond above the site of the main dam and left to be removed to some other location, was 600,377 cubic yards, removed from 458 acres. In 1900, 1,678,346 cubic yards were removed from 900 acres; this, added to the amount removed in previous years, makes a total at the end of 1900 of 2,278,723 cubic yards, or 34 per cent. of the estimated total, removed from 1,358 acres. Of the soil remaining, about one-half is provided for under existing contracts. On an accompanying plan of the reservoir the completed portions are shaded.

Of the soil removed to the end of the year 1900, 168,369 cubic yards were used for road embankments and for filling shallow flowage, and 2,110,354 cubic yards have been used in the North Dike. There have been 9,008 cubic yards of earth used during the year to cover deep muck to the depth of about 1 foot.

The soil used in constructing roads and that taken from the portion of the reservoir near the dike has been loaded into dump carts and hauled directly to the work. The remainder, and by far the larger part, has been loaded directly into cars, or first loaded into carts and then dumped into cars at the dumping platforms. A very large part of the soil loaded into cars has been hauled directly to the dike by locomotives over the main line of double 3-foot gage track which passes near the South Clinton station. A large portion, however, has been hauled by locomotives to the foot of two inclines, and there hauled by stationary engines to the top of a bluff, to be again hauled by locomotives at the higher level to the dike. One of these inclines was situated a short distance east of the main line of railway, and the other on the northerly side of the river, about midway between the South Clinton station and Sawyer's Mills.

The plant employed in this work, exclusive of horses and carts, has been: —

21.5 miles of 3-foot gage track.
25 locomotives, 8 to 16 tons.
725 cars, 1¾ to 3½ cubic yards capacity.
2 50-horse-power hoisting engines.

Soil has been removed during the year by the following contractors: —

Moulton & O'Mahoney,	Contract 150.
Cenedella Brothers,	Contract 160.
Nawn & Brock,	Contract 166.
Busch Brothers,	Contract 176.
Long & Little,	Contract 183.
Martin Murphy,	Contract 186.
Newell & Snowling Construction Company,	Contract 197.

Their operations are described more particularly under the head of contracts.

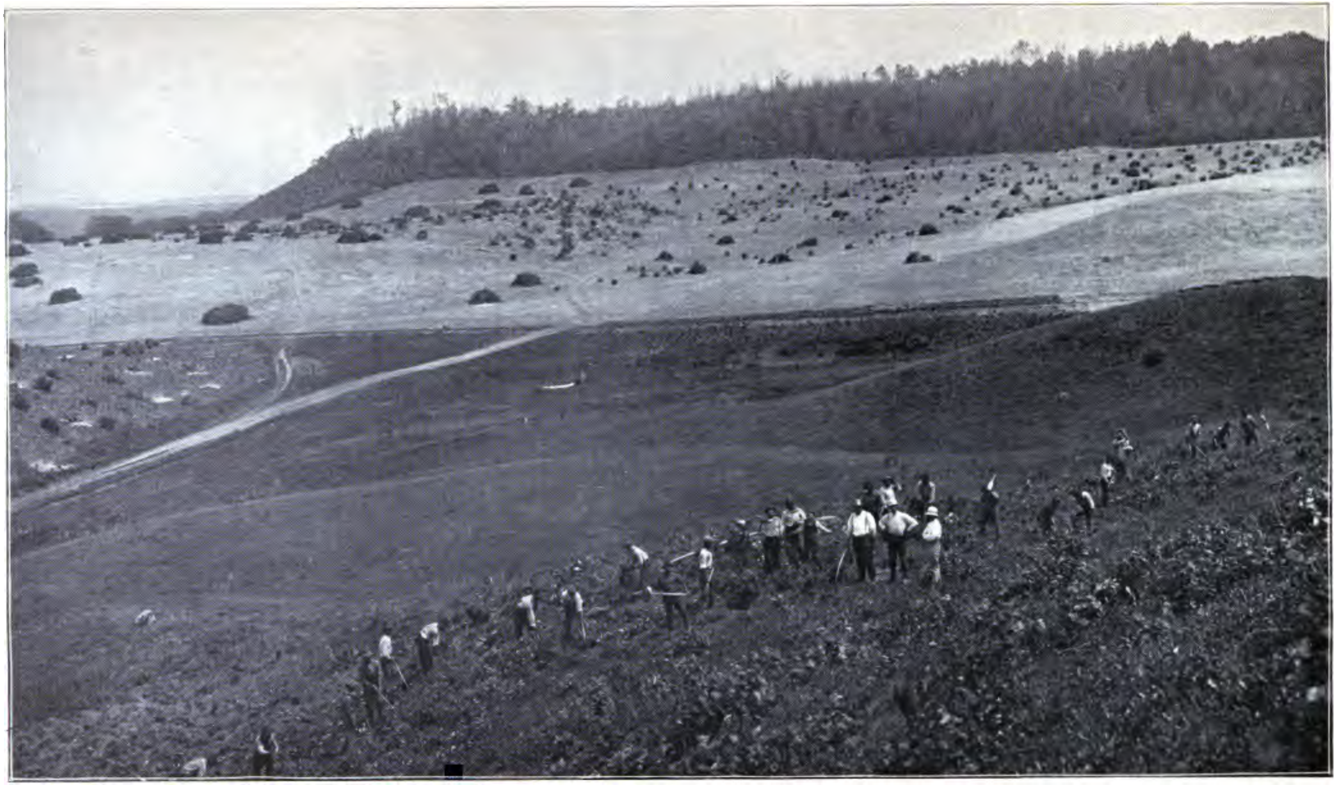
A day-labor force, under the direction of the engineering staff, removed 4,700 cubic yards of muck from 1.67 acres around the edges of Carville's Pond, leaving the central portion, where the muck is deep, to be covered with gravel. This work was commenced January 29, 1900, and completed June 26. The maximum force employed was 24 men and 8 horses, for the week ending June 16, 1900.

CONTRACTS, WACHUSETT RESERVOIR.

Contract 150, Moulton & O'Mahoney.

Excavating Soil from Section 4 of the Wachusett Reservoir, and excavating and refilling at the Easterly Portion of the North Dike, Clinton.

On April 10, 1899, a contract was made with Moulton & O'Mahoney for removing the soil from some 270 acres of the reservoir, near the easterly portion of the North Dike, known as Section 4, and rolling it in 6-inch layers in the main cut-off at the easterly portion of the North Dike, and also in the secondary cut-off, which their contract required them to make; the material from the second-



WACHUSETT RESERVOIR—GRUBBING PRELIMINARY TO SOIL STRIPPING; STRIPPED SURFACE AND MATERIAL TO BE BURNED IN DISTANCE.

ary cut-off to be used so far as practicable in the secondary embankment and in the road embankment near South Main Street on the new road from Clinton to Lancaster Street in West Boylston.

By far the larger part of the soil taken from this section has been removed in dump carts; but on that part of the section west of Sandy Pond and south of the former public road leading from Clinton to West Boylston, a portion of the soil was removed by a force loading directly into cars that were hauled by locomotives to the dike; and on the extreme southeasterly portion of the section some of the soil which was loaded into carts was hauled to a dumping platform, constructed for use on Section 6, where it was dumped into cars and hauled to the dike with soil from that section.

During the year the contractor has cleared and grubbed on the site of the reservoir 125 acres, and has removed 140,910 cubic yards of soil. This, with the 125 acres cleared and grubbed and the 196,300 cubic yards of soil removed during the previous year, makes a total of 250 acres of clearing and grubbing and 337,210 cubic yards of soil removed. During the year 6,251 cubic yards of earth were used in covering the muck at the bottom of a kettle-hole west of Sandy Pond. At the North Dike 11,240 cubic yards of earth have been removed; this, added to the 113,900 cubic yards removed during the previous year, makes a total at the completion of the contract of 125,140 cubic yards of earth excavation. There were also 3,821 cubic yards of soil excavated at the North Dike during the previous year, and in the same year a 30-inch brick barrel culvert was constructed beneath the road embankment.

The maximum force employed in 1900 was 197 men and 80 horses, for the week ending November 24.

The contract was completed on December 18, 1900, and included the following items: —

Clearing and grubbing (acres),	255.77
Soil excavation (cubic yards),	341,031
Earth excavation (cubic yards),	131,391
Masonry (cubic yards),	66.02
Dry paving (cubic yards),	21.33
The amount of the contract was	$157,130 37

The excess of the earth excavation over that called for by the preliminary estimate is mainly due to the addition to this contract of the unfinished portion (74,088 cubic yards) of the excavation for the main cut-off at the easterly portion of the dike, which was commenced under another contractor, who was unable to complete the work.

Contract 160, Cenedella Brothers.

Excavating Soil from Part of Section 5 of the Wachusett Reservoir, and excavating and refilling at the Westerly Portion of the North Dike, Clinton and Sterling.

This contract was made on June 1, 1899, and called for the excavation of the main cut-off trench at the westerly portion of the North Dike, the excavation of soil from the larger part of Section 5 situated in front of this portion of the dike, the construction of so much of the new road from Clinton to Lancaster Street in West Boylston as is situated behind this portion of the dike, and the construction of a drain at the northerly toe of the dike for the purpose of taking care of the surface water which falls between the dike and the road. The material excavated from the cut-off trench was used in constructing parts of the main embankment and the road embankments, and the remainder was deposited south of the northerly toe of the dike. The soil excavated, where suitable for the purpose, was deposited and rolled in 6-inch layers in the main cut-off, and, where unsuitable for this purpose, was deposited near the toe of the dike.

Some of the earth in the main cut-off was removed by derricks, but by far the greater part of the earth and all of the soil were removed by loading into carts.

During the year the contractors have excavated at the dike 1,489 cubic yards of soil and 19,307 cubic yards of earth; this, with the 7,900 cubic yards of soil and 133,800 cubic yards of earth excavated in 1899, makes a total of 9,389 cubic yards of soil and 153,107 cubic yards of earth excavated at the dike. On Section 5 the contractors have cleared and grubbed 70 acres and removed 123,349 cubic yards of soil; this, added to the 24 acres cleared and grubbed and the 72,700 cubic yards of soil removed in 1899, makes a total on Section 5 of 94 acres of clearing and grubbing and 196,049 cubic yards of soil.

The drain and the road were completed in 1899.

The maximum force employed during the year has been 211 men and 79 horses, for the week ending May 12. The contract was completed on August 18, 1900. The principal items in the final estimate are as follows: —

Clearing and grubbing (acres),	127
Soil excavation (cubic yards),	207,110
Earth excavation (cubic yards),	162,526
Masonry (cubic yards),	43
Dry paving (cubic yards),	53
Furnishing and laying sewer pipe for drains and culverts (linear feet),	7,194
Manholes,	18
The amount of the contract was	$82,358 40

Contract 166, Nawn & Brock.

Excavating Soil from Section 6 of the Wachusett Reservoir, and building the Easterly Portion of the North Dike, Boylston, Clinton and West Boylston.

On June 13, 1899, a contract was made with Nawn & Brock for completing the easterly portion of the dike, with the exception of the slope paving. The material for this purpose, with the exception of comparatively small amounts of sand and gravel, was to be obtained by stripping soil from some 1,700 acres, known as Section 6 ot the Wachusett Reservoir. By far the greater part of this section is located west of the South Clinton station and south of the Central Massachusetts Railroad. There is, however, a large area included in the section north and east of the South Clinton station and a small area comprising the bed of Coachlace Pond, immediately south of the dike.

Nawn & Brock have retained the control of the work on the portion of the section west of the South Clinton station, but on August 30, 1899, with the consent of the Board, sublet to Moulton & O'Mahoney that portion of the section north and east of the South Clinton station and that immediately south of the dike.

The principal contractors have loaded all their soil (except small amounts not conveyed to the North Dike) upon cars holding approximately 3½ cubic yards each, and during a large part of the year these cars were run in trains of 20 cars each. Twelve-ton locomotives were used to the foot of the grade leading from South Clinton to the dike and 16-ton locomotives on the grade.

The total number of carloads hauled during the year has been 285,861, amounting to 988,433 cubic yards; this, with the 39,737 carloads, containing 138,286 cubic yards, hauled the previous year, makes a total of 325,598 cars, containing 1,126,719 cubic yards.

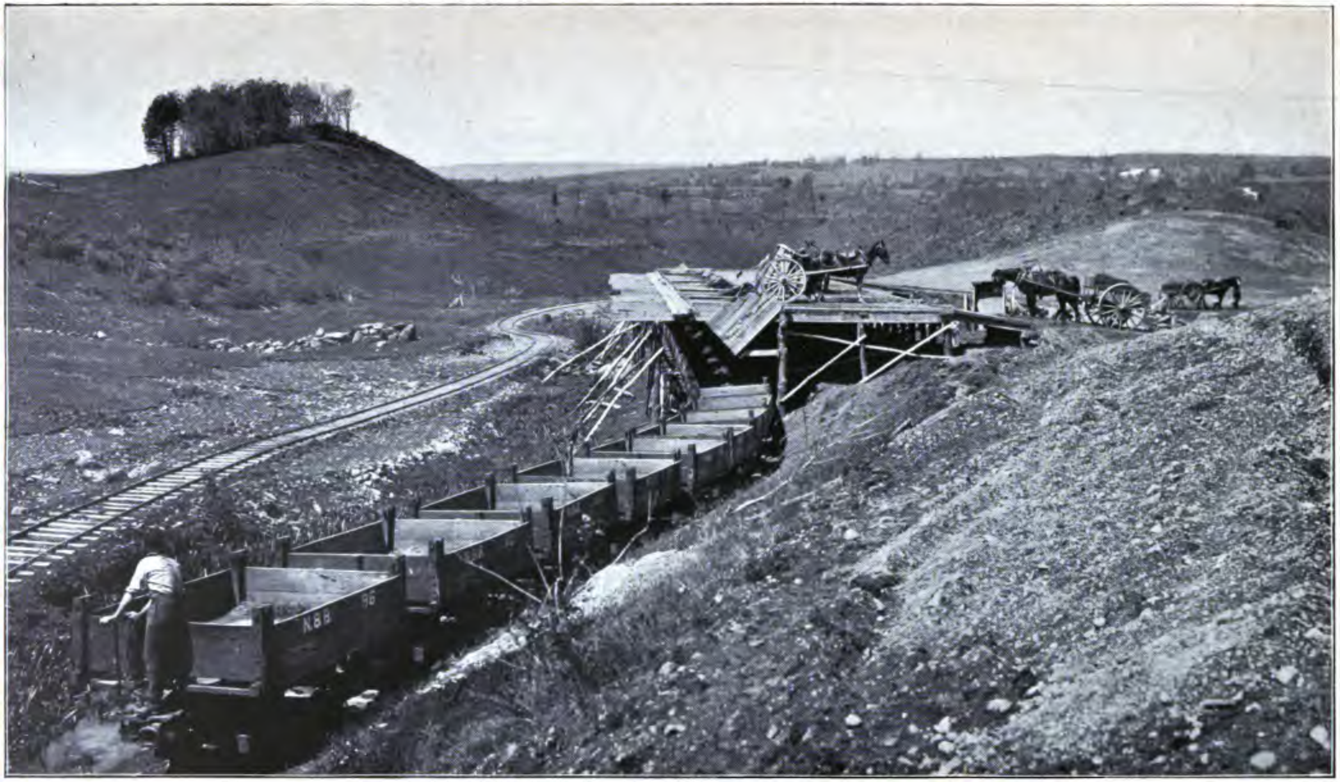
On the low ground along the river, where it has been practicable to do so, the contractor has loaded the soil directly into cars, throwing the track as the work progressed. On other portions of the work, where this method was impracticable, the soil has been loaded into carts and hauled to dumping platforms, where it has been dumped into the cars.

There have been 980 cubic yards of soil used in filling a small area of shallow flowage, a short distance east of the former public highway leading from Sawyer's Mills to Boylston Centre. There have been 167 cubic yards of earth used in covering muck, and 128 cubic yards have been deposited in a road embankment.

At the North Dike the soil from this section has been deposited mainly in the part of the dike at Coachlace Pond. It has been rolled in 6-inch layers for a distance of 100 feet north of the main embankment, deposited in 7½-foot layers between the rolled embankment and the secondary embankment, and deposited in such manner as the contractor deemed desirable between the secondary embankment and the northerly toe of the dike. The northerly slope of the dike up to contour 355 has been graded to the required form and has been accepted. There have been 16,906 cubic yards of earth and 780 of gravel, borrowed from the site of the reservoir, deposited in the main and secondary embankments, 610 cubic yards of the earth having been deposited in 1899.

Moulton & O'Mahoney, subcontractors, in 1899 removed the muck from the small area south of the dike at Coachlace Pond, by loading it into cars, hauling the cars up an incline to the level of the railroad embankment previously constructed, and then hauling this material along this railroad embankment to the north of the secondary cut-off, where it was deposited. There were 8,773 cubic yards taken from this area. The remainder of the soil hauled by the subcontractors from Section 6 to the North Dike was either loaded directly into cars on the low ground north of the Nashua River below South Clinton, or into carts, from which it was dumped into cars at dumping platforms, except 14,553 cubic yards (2,158 in 1899 and 12,395 in 1900) hauled directly to the North Dike in carts.

The soil loaded into cars was hauled by locomotives to the foot of the incline east of the road running northerly from Cunningham's bridge, hauled up the incline by a hoisting engine, and hauled by locomotives from the head of the incline to the dike. There were



WACHUSETT RESERVOIR—LOADING CARS AT DUMPING PLATFORM WITH SOIL STRIPPED FROM BOTTOM.

32,745 carloads, amounting to 81,776 cubic yards, hauled in this manner during the year; this amount, added to 9,300 carloads, containing 16,744 cubic yards, hauled during the previous year, makes a total of 42,045 carloads, containing 98,520 cubic yards.

At the North Dike the soil when suitable was deposited and rolled in 6-inch layers in and over the main cut-off, over the secondary cut-off, or in 7½-foot layers between the two cut-offs. When unsuitable for this purpose, it was deposited north of the secondary cut-off.

The plant employed by the principal contractors has been: —

16 8 to 16 ton locomotives.
500 dump cars, 3½ cubic yards capacity.
13.9 miles of 3-foot gage track.

That in use by the subcontractors has consisted of: —

5 8 to 12 ton locomotives.
1 50-horse-power hoisting engine.
4.4 miles of 3-foot gage track.
125 dump cars, having an average capacity of 2½ cubic yards.

The total amount of work done during the year under this con tract has been: —

	To December 31, 1899.	For the Year 1900.	Total to December 31, 1900.
Clearing and grubbing (acres), ...	45	306	351
Soil excavation (cubic yards), ...	168,800	1,080,745	1,249,545
Earth excavation (cubic yards), ...	660	16,541	17,201
Gravel excavation (cubic yards), ...	–	780	780

The maximum force employed during the year was 995 men and 116 horses, for the week ending October 20.

Contract 176, Busch Brothers.

Excavating Soil from Section 9 of the Wachusett Reservoir, and building a Road in West Boylston and Boylston.

This contract was made on July 29, 1899, for the purpose of constructing to subgrade a road from the junction of Temple and Pierce streets in West Boylston to the road leading from Boylston Centre to Shrewsbury, ready for the broken-stone surface of the road.

The work performed under this contract was as follows: —

	To December 31, 1899.	For the Year 1900.	Total to December 31, 1900.
Earth excavation (cubic yards), . . .	89,840	9,662	99,502
Rock excavation (cubic yards), . . .	1,892	1,075	2,967
Slope paving (cubic yards), ...	490	4,177	4,667
Masonry, ...	532	7	539
Sewer pipe and cast-iron pipe culverts (linear feet), ...	273	7	280

Of the total earth excavation, 43,755 cubic yards represent soil removed from the site of the reservoir, and used partly in the road embankments and partly in filling the shallow flowage along the margin of the reservoir in the vicinity of the road; 300 cubic yards of earth were also used in covering a small muck pocket below the flow line.

The maximum force employed on this contract during the year was 79 men and 45 horses, for the week ending May 5.

The amount of the contract was $35,160.63.

Contract 183, Long & Little.

Excavating Soil from Section 7 of the Wachusett Reservoir, and building a Part of the Westerly Portion of the North Dike, Clinton and Boylston.

This contract was made on December 12, 1899, and called for the excavation of 650,000 cubic yards of soil from 313 acres of the Wachusett Reservoir site, known as Section 7, and depositing it in the westerly portion of the North Dike, east of the railway opening through the main embankment. The section includes the intervale and the steep slopes on both sides of Cunningham's Brook, the intervale on the river between Clinton and Sawyer's Mills north of the Central Massachusetts Railroad, the steep slopes on the northerly side of the intervale and a portion of the Catholic Cemetery in Clinton. The contract also provides for the completion, with the exception of the slope paving, of the northeasterly 2,400 feet of the westerly portion of the North Dike, the completion of the main embankment of earth and gravel, and the partial construction of the soil embankment between the part to be completed and the railway opening.

No contract work was done previous to 1900. All the soil from the intervale between the Nashua River and the Central Massachusetts Railroad, and a small amount from the north side of the river, has been removed by a plant consisting of: —

1 50-horse-power hoisting engine.
4 12 to 15 ton locomotives.
100 dump cars, 2½ cubic yards capacity.
3.2 miles of 3-foot gage track.

The soil from the intervale is loaded into cars, hauled to the foot of the incline constructed up the slope midway between South Clinton and Sawyer's Mills, drawn up the incline by a 50-horse-power hoisting engine, and hauled by a locomotive from the head of the incline to the dike. There have been 63,563 carloads of soil, containing 176,587 cubic yards, removed from this area to the North Dike. Along Cunningham's Brook and at the old Catholic Cemetery a force working with horses and carts has transported 51,092 cubic yards of soil to the dike. A considerable amount of soil removed from the Catholic Cemetery has contained very little organic matter, and has been deposited in the earth embankment at the dike. There have been 164 cubic yards of earth taken from Section 5, east of the old West Boylston Road, and used in reenforcing the northerly side of the earth embankment at the water slope of the dike. There have been 1,700 cubic yards of earth used to cover the deep muck at the foot of the steep slope on the north side of the intervale between South Clinton and Sawyer's Mills. There have been 655 cubic yards of gravel used in facing the water slope of the main embankment.

The total quantities of work performed under this contract have been as follows: —

Clearing and grubbing (acres), ...	46
Soil excavation (cubic yards), ...	227,679
Earth excavation (cubic yards), ...	1,864
Gravel excavation (cubic yards), ...	655

The maximum force employed during the year was 208 men and 49 horses, for the week ending October 27.

Contract 186, Martin Murphy.

Transporting Soil and Earth from St. John's Catholic Cemetery to the North Dike, Clinton.

The contract of the committee of the St. John's Catholic Cemetery with Martin Murphy for the removal of bodies from the old Catholic Cemetery, called for the excavation to a depth not exceeding 6½ feet of a certain area at the old cemetery southeast of the old county road leading through the cemetery. As this contract required the handling of all the material, an additional contract was made with Martin Murphy to load this material into carts, haul it to the westerly portion of the North Dike, and deposit it partly in the earth and partly in the soil embankment. This work was commenced on April 6, 1900, and was completed on September 18.

The total quantity removed was 18,882 cubic yards. The maximum force employed was 17 men and 28 horses, for the week ending April 21.

Contract 187, Thomas H. Gill.

Culverts on the Shrewsbury Road, West Boylston and Boylston, and on the Worcester Road, Boylston.

This contract was made on April 28, 1900, for the construction of the necessary culverts on that portion of the Shrewsbury Road in West Boylston, between Worcester Street and Pierce Street, formerly known as Temple Street, for some additional culverts found necessary on the remaining portion of the Shrewsbury Road, and for the rebuilding of the culvert washed out on the Worcester Road in Boylston, near the Shrewsbury Road. The work was completed on August 13. The maximum force employed on this contract was 36 men and 11 horses, for the week ending June 9, 1900.

The principal items in the final estimate are as follows: —

Earth excavation (cubic yards),	1,365
Slope paving (cubic yards),	196
Masonry (cubic yards),	297
Sewer and cast-iron pipe culverts (linear feet),	471
Sewer pipe for side drains (linear feet),	349
The amount of the contract was	$6,930 21

Contract 189, T. Stuart & Son.

Improving Part of Section 1 of the Shrewsbury Road, and surfacing the Section with Broken Stone, West Boylston and Boylston.

This contract was made on June 9, 1900, for the purpose of regrading that portion of the Shrewsbury Road between Worcester Street and Pierce Street in West Boylston, formerly known as Temple Street, and for surfacing with broken stone the above-mentioned portion and also the portion of the same road between Pierce and Hartwell streets, approximately to the line between West Boylston and Boylston, a total length of 7,673 feet. Work was commenced under this contract on June 18 and completed on September 15. The maximum force employed was 40 men and 14 horses, for the week ending July 21.

The final estimate showed the following quantities of work performed: —

Earth excavation (cubic yards), ...	6,520
Rock excavation (cubic yards), ...	226
5-inch sewer pipe for side drains (linear feet), . . .	1,009
Shaping surface of road-bed (linear feet), ...	7,673
Broken stone in place (tons, 2,000 pounds), ...	5,109
The amount of the contract was	$14,806 59

Contracts 190 and 191, F. E. Ellis.

Surfacing Sections 2 and 3 of the Shrewsbury Road with Broken Stone, Boylston.

These sections were respectively 6,681 and 5,795 feet in length. The contracts, dated June 11, 1900, called for surfacing with broken stone that portion of the Shrewsbury Road between the end of Section 1 and the road in Boylston leading from Boylston Centre to Shrewsbury. Work on Section 2 was commenced July 11 and completed on October 1, the maximum force employed being 48 men and 68 horses, for the week ending September 15, 1900. Work on Section 3 was commenced July 3 and completed on October 1, the maximum force employed being 44 men and 56 horses, for the week ending August 11.

The final estimate showed the following quantities of work performed: —

	Section 2.	Section 3.
Earth excavation (cubic yards),	1,101	952
Shaping surface of road-bed (linear feet),	6,681	5,795
Broken stone in place (tons, 2,000 pounds),	4,003	3,586
Amount of contract,	$10,654 35	$9,451 95

Contract 197, Newell & Snowling Construction Company.

Excavating Soil from Part of Section 8 of the Wachusett Reservoir, and depositing it in the Westerly Portion of the North Dike, Clinton and Sterling.

As a larger proportion than was expected of the soil taken from Section 5 of the Wachusett Reservoir by Cenedella Brothers, under Contract 160, was found to contain so much organic matter as to render it unsuitable for rolling in 6-inch layers in the main cut-off, a considerable portion of this cut-off near the old West Boylston Road was left unfilled under this contract. On August 7, 1900, a contract was made with the Newell & Snowling Construction Company for excavating the soil from a part of Section 8 of the reservoir, and completing the filling of this portion of the cut-off. Work on this contract was commenced August 17, and prosecuted vigorously, so that it was completed on November 24. The maximum force employed was 153 men and 94 horses, for the week ending September 29.

The final estimate showed the following quantities of work performed: —

Clearing and grubbing (acres),	60
Soil excavation (cubic yards),	81,970
Earth excavation (cubic yards),	1,792
The amount of the contract was	$28,763 90

Of the above amount of earth excavation, 902 cubic yards were removed from the cut-off and 890 were used to cover muck in the bottom of a kettle-hole.

LAND SURVEYS.

There have been 193 acres of land surveyed and about 50 of the land plans have been revised. Seven and one-half miles of taking lines have been run, and 163 stone monuments and 5 iron bolts have been set on these lines. Taking plans for 1,074 acres of land on the Wachusett Reservoir site have been prepared during the year, making to the end of the year 1900 a total of 7,500 acres. Seven land plans for the use of the Attorney-General in land suits have been made. Some seven miles of land lines have been rerun.

REAL ESTATE, CARE AND DISPOSAL.

Rents have been collected on houses in the possession of the Board, and a considerable quantity of land products have been sold. There have been 8,315 linear feet of farm fences constructed; various lists of the assessed valuation of property owned by the Commonwealth in the towns of West Boylston, Boylston, Clinton, Sterling and Lancaster have been made. A fire line 40 feet wide has been cleared off around the margin of land purchased by the Board for 37,230 linear feet, in order to have an open space for the purpose of fire protection. There have been 22.9 acres of woodland cleared, the underbrush cut and in some cases burned; 1.9 acres have been cleared and grubbed for a nursery on the south side of the reservoir. Twelve bushels of sugar maple seeds, 12½ bushels of white oak acorns and 1½ bushels of chestnuts have been gathered; 56,564 square feet have been planted with maple seeds, 15,030 square feet with white oak acorns, and 880 square feet with chestnuts at the nurseries. There have been 1,793 pine trees, from 1 to 6 feet in height, taken from below the flow line near Sawyer's Mills and set out on the margin of the reservoir near the North Dike; 6,850 pine trees, from 1 to 6 feet in height, have been taken from the southerly arm of the reservoir below the flow line, and set out along the south side of the reservoir in Boylston; 175,000 pine seedlings and 200 sugar maple seedlings have been transplanted at the nurseries.

A new water supply has been obtained at the Lamson house on the north side of the reservoir in Boylston, and the house has been repapered and repainted. At the Tonry house in Clinton, which is occupied by one of the foremen in the employ of the Board, a new barn has been built, certain repairs have been completed, the house has been repainted, the ground around it graded, plumbing put in and a cesspool built. In West Boylston 4 houses belonging to the L. M. Harris Manufacturing Company and 10 belonging to the Clarendon Mills have been torn down, and 15 other houses, 8 barns and 1 store have been torn down by a day-labor force or have been sold to be removed, making a total of 38 buildings removed during the year.

SANITARY INSPECTION.

The site of the Wachusett Reservoir has been carefully cared for by the sanitary and medical inspectors during the entire year, and during the latter portion of the year the sanitary inspection has been extended over the entire watershed. By the building of cesspools and the removal of buildings, 44 cases of direct or indirect pollution to the water supply through house drainage have been removed. A member of the engineering staff was detailed to make a study of the sanitary conditions as they exist during the summer seasons at the Sterling camp and picnic grounds, the data thus obtained to be used in determining the sanitary inspection needed in the future in this locality.

Several cases of tyhoid fever on the watershed have been discovered, 6 being reported from Lovellville, 3 from Chaffinville and 6 from Boylston. Five of the cases in Boylston, being on land owned by the Commonwealth, were removed to the Clinton Hospital. One of these patients died. In every case the premises were visited as soon as possible by the sanitary inspector, and precautions were taken to prevent the spread of the disease.

The physicians in the various towns not having reported cases of typhoid fever, circulars from the State Board of Health were distributed, quoting the law on the subject.

The general health of the people dwelling on the watershed and of those employed upon the reservoir has been good.

Contractors' barns and camps have been kept in fair condition. This, however, has required constant care, as the average laborers do not keep their premises in sanitary condition unless compelled to do so. In order that the sanitary conditions might be more carefully watched, near the close of the year a rodman on the engineering staff was assigned to the duty of assisting the sanitary and medical inspectors.

REMOVAL OF BODIES FROM ST. JOHN'S CATHOLIC CEMETERY.

This work, commenced near the close of the preceding year by a committee has been continued. This committee has removed during the year 3,659 bodies, which, with the 157 bodies removed during the previous year, make a total removed by them of 3,816.

After notice from the officials of this committee that the removal of bodies was completed, consent was obtained from the Bishop to enter upon the premises for the purpose of removing soil and earth. This work was commenced on October 20, 1900. Since then 26 bodies have been found and turned over to the representatives of the committee.

MISCELLANEOUS.

The paving outside the road locations along the margin of the reservoir has been maintained. The ditch connecting east and middle Washacum ponds has been cleaned out. The outlet of these ponds has also been cleaned out and the gate repaired. The brush on public roads in front of land belonging to the Commonwealth has been trimmed up for a distance of 8,375 linear feet on both sides of the road, and for a distance of 11,200 feet on one side of the road.

A private telephone line has been maintained.

Sixty stone guard rail posts on discontinued roads have been cut over for monuments.

ENGINEERING.

In addition to the engineering work already enumerated, the engineering staff of the reservoir department has performed the following work: Gage readings have been taken on storage ponds above the main dam, on the 1st and 15th of each month, beginning June 1, and the storage at each date computed. Information in regard to plans and descriptions of real estate have been furnished to the Conveyancing Department. Elevations covering some 150 acres of the final surface of the bottom of the reservoir have been plotted on record sheets and contours drawn, for the purpose of computing the capacity of the Wachusett Reservoir. Two stone monuments have been erected on town boundaries. Some preliminary work has been done on the relocation of the railroads at Oakdale. A survey has been made and a plan drawn of the Bigelow Carpet Company's yard and buildings near Coachlace Pond.

DAM AND AQUEDUCT DEPARTMENT.

THOMAS F. RICHARDSON, *Department Engineer.*

The work of construction in this department during the year has related mainly to work at the Wachusett Dam and to the construction of ditches for the drainage of swamps upon the Wachusett watershed. This department also had charge, until September 24, of the surveys and investigations for the new Weston Aqueduct, and has had charge of the maintenance and operation of the Wachusett Aqueduct and the Clinton Sewerage System.

The organization of the engineering force during most of the year has remained substantially the same as at the end of the previous year. Chester W. Smith, assistant engineer, has had charge of the work at the Wachusett Dam. George W. Booth, assistant engineer, has had charge of surveys and investigations for the Weston Aqueduct. Marshall Nevers, assistant engineer, was in charge of the swamp improvement on the Wachusett watershed until July 25, when he was transferred to the Weston Aqueduct. Dan B. Clark, assistant engineer, has been in charge of a party making swamp surveys in the Wachusett watershed and making investigations for a sewerage system in the valley of the Quinepoxet River, until he was transferred to the Weston Aqueduct, on November 16. Ernest G. Hopson has continued as head draftsman at the Clinton office. John L. Hildreth, Jr., has been in charge of the river and aqueduct gagings, until he was transferred to the Weston Aqueduct, on November 16, when the work was put in charge of Elliot R. B. Allardice. The engineering force at the beginning of the year was 27, reached a maximum of 31 on September 22, and at the end of the year numbered 16.

The main office of the department has been in the building belonging to the Board at Clinton. A branch office has been maintained at Weston, and until July 25 there was another branch office at West Boylston. On September 5 a branch office was established on River Street, Clinton, for the work at the Wachusett Dam.

WACHUSETT DAM.

During the year the design of the Wachusett Dam has been completed and the work has been placed under contract.

At the place where it is to be built the width of the valley at full-reservoir level (elevation 395) is 1,250 feet, and the bottom of the river is 129 feet below this level. The slopes rise rapidly from the river on both sides of the valley, but on the northwesterly side, at a comparatively short distance below the full-reservoir level, there is a nearly level bench, and down stream from it a natural valley leading to the river about 800 feet below the dam. Advantage was taken of these conditions to divide the dam into two parts: first, the

main dam crossing the valley, with its top rising so high above the reservoir that no water can run over it; and, second, a waste weir built along the bench for the discharge of flood waters. In order to give the waste weir a sufficient length, it is carried up stream at an angle with the main dam, and then turns again and runs nearly parallel with the main dam to the shore. The whole dam is to be constructed of stone masonry founded upon solid rock.

The principal features of the work to be done under the contract are the main dam with its two terminal structures, the waste weir and waste channel, the up-stream and down-stream gate-chambers, the waste conduits and a waste pool below the dam, and the regrading of the grounds.

Three plans of the dam accompany this report: Sheet No. 1 is a general plan of the dam and all of its appurtenances; Sheet No. 2 shows the cross-section of different parts of the main dam and waste weir, and a longitudinal profile of the dam; Sheet No. 3 shows details of gate-chambers.

Main Dam.

The main dam will be 850 feet long between terminal structures, and at the deepest part of the gorge will probably exceed 200 feet in height above the excavated rock foundation. In the deepest part of the valley the distance from the full-reservoir level to the surface of the rock at the down-stream edge of the dam is 179 feet. The top of the dam will be built 20 feet above the full-reservoir level. The thickness of the dam at this level will be 25 feet, and 175 feet below this level will be 176.3 feet.

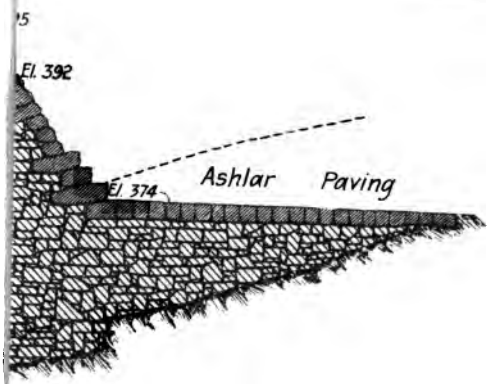
The cross-section of the dam is thicker and higher above the water than that of nearly all existing dams, and very much thicker than that of many of the high masonry dams which have been successfully used to retain water. The increased thickness is due in large part to making provision for possible stresses from forces not usually considered in designing dams, and in large part to the desire to provide a very large factor of safety for this location, where very great damage would result from the failure of a dam which holds so large a quantity of water.

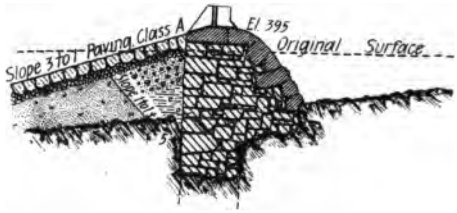
In order to make the dam as nearly homogeneous as possible, it will be composed wholly of rubble masonry, with the exception of a thin facing of ashlar on the exposed portions.

The rubble masonry is to consist of large pieces of quarried granite, having a flat or slightly convex bed, which, in the greater part of the dam, will be laid in natural cement mortar mixed in the proportion of two parts of sand to one part of cement. Small stones will be used in preparing the beds for the large stones, and for filling the spaces between the large stones. Every space between stones is to be completely filled with the mortar.

A triangular section of the dam at the deepest part of the valley, having a base extending about 150 feet up stream from the toe, and a height of about 50 feet, is to be laid in Portland cement, on account of the larger stresses when the reservoir is full, in this portion of the dam. The portion of the excavations not filled with masonry will be refilled with earth, and above this refilling the earth is to be raised against the dam in the bottom of the valley to a height of about 34 feet above the bottom of the river. The up-stream face of the rubble where earth is to be filled against it will be made with specially selected stones, so as to have small joints, and these joints will be very carefully pointed, with a view to making them water tight. As an additional precaution, about 10 feet in thickness of clayey material will be deposited against the up-stream face of the dam, and carefully compacted in thin layers.

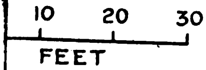
Above the level of the earth filling, the facing of the dam will consist of granite ashlar laid with ½-inch joints. The ashlar on the up-stream face is used mainly because the joints can be made more nearly water tight than with rubble masonry, and the ashlar will also resist the action of the frost, when the water is drawn down, better than the rubble. On the down-stream face and on the up-stream face above the water line the ashlar is used, both for the purpose of improving the appearance of the dam and on account of its ability to stand the action of frost. As the ashlar is used for the purposes above stated, and not because it has any advantage in regard to strength, it is made only thick enough for these purposes. On the up-stream face the lower portion of the ashlar will have a thickness of only 14 inches, and the upper portion of only 12 inches; but long headers will be provided at frequent intervals, to tie the facing to the rest of the masonry. On the down-stream face of the dam the ashlar will have an average thickness of not less than 12 inches. As ashlar masonry with ½-inch joints would be much less easily compressed than the rubble, high stresses would be produced if the joints were made to the full depth of 12 inches; and it was therefore

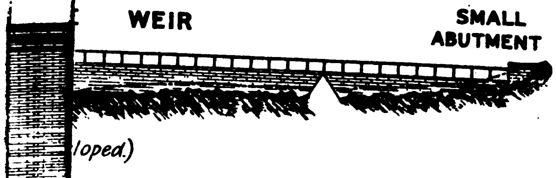




Section BB

of Waste Weir





TT DAM

ream Elevation

Sheet No. 2

GEO. H. WALKER & CO. BOSTON.

thought advisable to limit the longitudinal joints to a depth of 4 inches, and not to point them until the dam shall be nearly completed. There is a very considerable slope on the down-stream side of the dam, which will tend to hold the ashlar in place, and, in addition, it will be securely bonded to the rest of the dam by frequent long headers.

Terminal Structures.

To give the dam a more pleasing architectural appearance, and for other reasons, its northwesterly end is to terminate in a circular bastion and its southwesterly end in a semi-circular abutment. In the bastion a room is to be constructed, in which the flashboards from the waste weir can be stored. At the southwesterly end the abutment is carried out a short distance into the reservoir beyond the natural flow line, both to improve the appearance and to diminish the cost. In shore from the abutment, a core wall, founded upon the rock, is to be built for a distance of about 95 feet.

Waste Weir.

The waste weir will have a total length of 450 feet, but the effective length will be somewhat less, owing to the space occupied by supports every 10 feet for the bridge along it. For 100 feet from the bastion the stone masonry of the weir will be kept 3 feet below full-reservoir level, and for the remainder of the length at full-reservoir level.

Access to the whole length of the weir will be provided by a foot bridge placed 7 feet above full-reservoir level, and supported by iron standards, which will also act as flashboard grooves up to a level 3 feet above that of the full reservoir. The flashboards above the full-reservoir level are intended to prevent the loss of water from waves dashing over the crest; but they will not be used for raising the water above the normal level of the reservoir, and will be removed when the reservoir is covered with ice, or there is surplus water.

In many cases it would be undesirable to have a bridge over a weir supported by frequent strong iron supports; but in the present instance there is no danger from logs, stumps or other floating debris during a freshet, because the reservoir is so large that such floating substances cannot find their way from the large streams at the upper end to the lower end during the continuance of the freshet. The supports will be advantageous rather than otherwise, in preventing the ice from going over the weir.

The crest of the waste weir will be rounded on its down-stream side sufficiently to cause the water to follow the masonry, except possibly at the depressed section. Below the rounded crest there will be a facing of ashlar, and toward the bottom of the down-stream face the ashlar will be built in steps to receive the impact of the falling water. Where the fall of water to the ledge below the waste weir is more than 21 feet, the depression is to be filled with rubble masonry, having a top surface of paving laid in Portland cement mortar.

When the flashboards on the depressed portion of the waste weir are in place, the weir, with a depth of 5 feet on the crest, will discharge in twenty-four hours a quantity of water equal to 4.9 inches in depth over the whole watershed, and, with a depth of 7 feet on the crest, will discharge 8 watershed inches. Moreover, to raise the water in the reservoir 5 feet above the level of the crest will require a run-off of 3.4 watershed inches, and to raise it 7 feet will require a run-off of 4.75 watershed inches. Taking into account the modifying effect of storage in the reservoir, as indicated by these figures, it seems probable that a run-off from the watershed of 8 inches in twenty-four hours will not raise the water more than 5 feet, if at the level of the crest at the beginning of the freshet.

Waste Channel.

For the waste channel, as already stated, a favorable natural location exists. In front of the waste weir only earth excavation will be necessary, but a retaining wall resting upon the ledge has to be built for about 500 feet down stream from the bastion, to prevent the flood waters from scouring away the earth which it is to retain. About 100 feet below the waste weir, in addition to the earth excavation, a channel is to be excavated in the rock, which, opposite and below the lower end of the retaining wall, will contain the whole of the water of any probable freshet. At its terminus the channel is to be made much wider and of less depth, for the purpose of diminishing the velocity of discharge into the river.

The rock excavation for the channel will be wholly in granite.

Pipes through the Dam.

Four 4-foot cast-iron pipes are to be embedded in the masonry of the dam, with their bottoms at elevation 284. These will be used for supplying water to the aqueduct and to turbines, and for wasting water into the river below the dam. As waste pipes, they will have an aggregate capacity of 2,500 cubic feet per second when the reservoir is nearly full, and a draft of this quantity will lower the reservoir 1.25 feet per day when no water runs into it.

Upper Gate-chamber.

The arrangement of the gate-chamber can be understood best by reference to Sheet No. 3, and the description in this place will relate mainly to the purpose of the design.

Two vertical wells are provided for each 4-foot pipe, the up-stream one containing the gates and the down-stream one conveying to the pipe the water which has passed through the gates. At a depth of 68 feet below full-reservoir level and 43 feet above the bottom of the 4-foot pipe, the up-stream well is divided by a horizontal diaphragm. Below this diaphragm, which will not be closed until the water in the reservoir has been permanently raised above its level, there is to be a 4-foot gate to control the flow through the short length of 4-foot pipe which leads from the reservoir to the bottom of the down-stream well. This gate will be used, while the dam is under construction and while the water in the reservoir has but a small depth, to regulate the flow of water, but afterwards is to be permanently closed, although provision will be made for opening it should it become necessary in any emergency. The diaphragm will also be closed, so that in the regular operation of the works the lower section of the up-stream well will be abandoned, and the upper part, which remains in use, will have a depth of only 65 feet below full-reservoir level to the stop-plank sill. The upper part of the well which remains in use will contain two 2½-foot by 6-foot gates, one at the bottom of the chamber and the other half-way up.

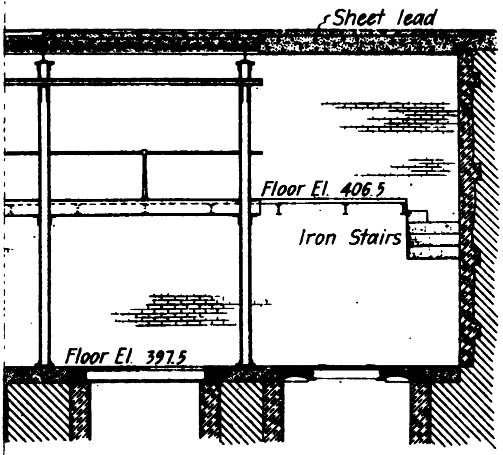
By this arrangement, under all ordinary conditions of operation, the upper gate, which will have a head of but 30 feet upon it when the reservoir is full, can be opened first to fill the pipe and lower well, so that the lower gate can be opened after the pressure upon it has been relieved. Gates of this size, however, can be successfully operated under the full head on the lower gate, which will not exceed 62 feet.

The water is to flow from the reservoir into the upper portion of each upper well through six ports, each 8 feet high and 2½ feet wide. On the reservoir side of these ports it is expected that coarse screens will be used, to prevent large pieces of water-logged wood from entering. These grooves can also be used, in case of necessity, for guiding a gate to close the up-stream end of the 4-foot pipe. On the down-stream side of the ports are three pairs of grooves, 30 inches between faces, extending from the top to the horizontal diaphragm across the well, and designed to receive either stop-planks or screens. The narrower width of opening than has usually been adopted will permit the use of comparatively thin stop-planks, which can be fastened together in sections 10 feet in height, without making them too heavy for convenient handling with appropriate machinery. It is desirable that these should be easily handled, as it is the intention to regulate the depth for drawing water from the reservoir by the use of sections of light stop-planks and open frames in these grooves, the open frames to be placed opposite the ports from which it is desired to draw the water. The stop-plank grooves may also be used for screens, sufficiently fine to prevent substances from passing which would interfere with the operation of the turbines.

Owing to the unusual height of the top of the dam above the reservoir, it has been found feasible to construct a room over the wells for the operation of gates and stop-planks so that it will not project above the level of the top of the dam.

Lower Gate-chamber.

The lower gate-chamber is located immediately below the dam, without encroaching upon its cross-section, and is to serve also as a head house for the Wachusett Aqueduct and a power house for utilizing the power of the water as it falls from the reservoir to the aqueduct. Each 4-foot pipe passes through the four wells into which this structure is divided. The first well is a dry one, in which the eight 2-foot gates will be located on branches from the 4-foot pipes, for regulating the flow of water into the aqueduct. These gates are connected with pipes which will discharge into a



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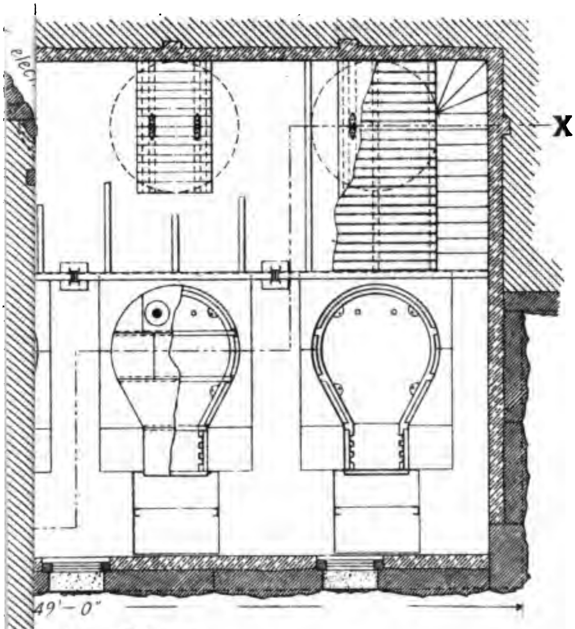

al Plan

TT DAM

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of Gate-Chambers

Sheet No. 3

GEO. H. WALKER & CO. BOSTON.

4-foot perforated pipe, known as a diffuser, which will be located in the second well. The second and third wells will contain the feed pipes to the turbines, which are to be located at a higher level, and the discharge pipes from the turbines. The fourth well will, under ordinary circumstances, be a dry well, containing a 4-foot gate on each of the 4-foot pipes; but if the quantity of water discharged should by accident be in excess of the capacity of the aqueduct, the surplus water will overflow into the fourth well, and thence, through two 5-foot pipes which have no gates upon them, into the waste conduits.

All the wells in this gate-chamber and in the waste conduits and pool to be described below are to be connected by drainage pipes with a pump-well at a low level, to be built at one end of the fourth well, and a pump will be provided for removing the water.

The exact arrangement of the turbines has not yet been fully determined, nor has the superstructure which is to serve as a power house been designed. The plans of the substructure may therefore require enlargement or modification.

Waste Conduits and Pool.

Immediately below each 4-foot gate in the fourth well of the lower gate-chamber each pipe is to increase in diameter at the rate of 1 foot in 10 until it becomes 8 feet in diameter, where the construction is to be changed from iron to concrete, the size continuing to increase at the same rate until the diameter is 10 feet.

The diverging pipes will increase the discharge of the 4-foot pipes, and at the same time will cause a very desirable reduction in the velocity. When the velocity through the 4-foot pipe is 50 feet per second, it will be 12½ feet per second at the end of the iron pipe and about 8 feet per second at the end of the enlargements in the masonry.

From the end of the enlargements there will be four 10-foot concrete masonry conduits carried side by side to convey the waste water to a central pool 55 feet in diameter, where they discharge through many openings in the bottom of the pool, which are so proportioned that the mean velocity of discharge will be about 4 feet per second, corresponding to a head of only 3 inches. The central pool will be surrounded by a low coping, and will be located in the middle of a pool 150 feet in diameter, having an opening 110 feet in width on the down-stream side, through which the water will flow out into the upper end of the river channel. The coping around the inner pool is at such a height that it will be above the level of the backwater from the Lancaster Mills dam, and the waste conduits and pool can be readily drained for inspection and repairs by operating the drainage pump.

Grading.

The contours on Sheet No. 1 show the grounds as it is intended to modify them by grading. In some cases quite extensive fills are to be made with the waste material, which will be made to conform to the contours shown upon the plan, and neatly finished and planted. Olmsted Brothers, landscape architects, of Brookline, Mass., have advised in matters relating to the landscape treatment of grounds.

Summary of Work done at the Dam in Previous Years.

Very extensive borings with wash drills and diamond drills were made between August 7, 1895, and July 9, 1896.

In June and August, 1897, the dam of the Lancaster Mills was torn down, a 24-inch cast-iron pipe was laid from a point above the Wachusett Dam to the canal of the Lancaster Mills, and a pump was installed on a raft in the river for supplying water to this pipe, so as to furnish clean water to the Lancaster Mills. All of this work was done to provide for emptying the mill pond, and to permit the beginning of work near the site of the Wachusett Dam.

On July 31, 1897, the construction of a temporary dam of earth, a short distance above the site of the main dam, was begun, both for the purpose of diverting the water of the river into the Wachusett Aqueduct, then under construction, and of protecting the deep excavation which it would be necessary to make in the bottom of the river to obtain a foundation for the main dam. Two flumes were constructed through this dam. The smaller one, leading to the head of the aqueduct tunnel, where it crosses the dam, was placed in a trench about 40 feet deep, so that it would rest upon solid rock and not be undermined by the subsequent excavation for the dam. The larger flume, which was intended for the discharge of the flood waters of the river, was at this time built for a length of about 200 feet. This dam was substantially completed at the end of 1897.

The completion of the protective work at the main dam required the extension of the large flume about 500 feet, and the construction of a second dam of earth across the valley a short distance above the lower end of this flume, to protect the excavations for the main dam from backwater. As the flume is a large structure, 40 feet in width inside, it seemed very desirable that all excavations should be made and a portion of the masonry of the main dam built at its site before building the flume, as the work could then be done much more economically than with the flume to support during the operations. Consequently, a contract was made with Busch Brothers, of Buffalo, N. Y., on June 19, 1899, for the excavation of earth and rock and the construction of masonry at the site of the flume. The work proceeded rather slowly, and the amount of rock requiring removal was much larger than was anticipated; so that it became evident in the autumn that it would be dangerous to defer the construction of the flume until the masonry could be built, as the flume might not be finished in time for the winter and spring freshets. It was therefore decided, after substantially completing the excavations, to support the flume upon posts where it crosses the site of the dam.

Almost from the first organization of the Engineering Department much attention has been given to the design and location of the dam, but the dam has not been needed to insure a sufficient supply of water of good quality. The rapid increase in the consumption of water in 1899, as compared with 1898, emphasized the need of beginning the dam without further delay, and since the summer of 1899 it has been given the first place in the work of the chief engineer, with the aid of the consulting engineers, and in the drafting office.

Work done in the Year 1900, before the Letting of the Contract.

Early in 1900 the main features of the dam had been decided upon, but there was considerable delay in reaching a conclusion as to details, so that at the beginning of July it became obvious that the reaching of final conclusions, the preparation of plans and specifications and the advertising of the work for a sufficient time would not permit the making of a contract until the autumn.

It had become obvious, from the great increase in the consumption of water in the last two years, and from the lowering of the reservoirs in 1899, owing to the very dry season, that the work of laying masonry at the dam ought to be begun as soon as the weather would permit in 1901; and, as there was an extensive excavation to be made in the bottom of the valley before any masonry could be laid, it was decided to begin at once to complete the protective works and to make this excavation, either by preliminary contract or with a day-labor force. The prices asked for the work by a contractor who had a large force available for beginning upon it at once were so high that it was concluded that it would be better to undertake the work with a day-labor force, under the direction of the department engineer.

Day-labor Work in the Year 1900.

During January advantage was taken of the thick ice upon the pond above the temporary dam to build the narrow levee of rock where the pond was shallow, to enclose a dumping ground for material from the deep excavation for the dam, so that when earth was dumped at this place it would not injure the quality of the water to be supplied to the Lancaster Mills or sent through the aqueduct. The ice was sufficiently strong to bear the weight of teams, and openings were cut through the ice to allow the stone to be dumped.

On February 13 and March 2, 1900, there were two exceptionally large freshets, which will be referred to later. The flume successfully conveyed the large volumes of water at these times, but, owing to causes which will be mentioned in giving a description of these freshets, was lifted from its foundations in places, and required a large amount of work to replace it in its original position. This work was begun immediately after the freshet of February 13, and was continued until July 21.

As soon as it was decided to make the excavations for the dam by day labor, a force was organized which began work on July 9. The main contract, made subsequently, provided that this day-labor force might continue to work until the contractor was ready to begin work at an equal or greater rate. It therefore continued until October 13.

From July 9 to September 24 the material was removed from the excavation with horses and carts. On the latter date a car plant was put in operation, and after it had been in use two days was operated by both day and night gangs. The material was hauled from the pit up an incline having a 20 per cent. grade, by means of a hoisting engine and cable, and hauled from the head of the incline to the dumping ground by horses. A total of 43,618 cubic yards of earth and 28 cubic yards of rock was excavated, uncovering the rock walls on both sides of the valley, and lowering the bottom of the excavation to elevation 247, or about 22 feet below the bed of the river.

The material excavated was used to construct the lower protective dam and to grade the grounds below the dam on both sides of the river, and the surplus was wasted above the dam either at the side of River Street, above the level of the pond, or behind the levee already mentioned.

An average force of 152 men and 51 horses was employed on this work, the maximum force being 190 men and 68 horses.

Main Contract, Wachusett Dam.

On October 1, 1900, a contract was made with McArthur Brothers Company, of Chicago, Ill., for the construction of the Wachusett Dam and its appurtenances, with the exception of the superstructure of the lower gate-chamber and some metal work. The amount of the contract upon the basis of award was $1,603,635. Nearly all kinds of excavation and masonry were divided into classes, for which different prices were bid. The principal estimated quantities of work to be done, and the maximum, minimum and average prices, are as follows: —

ITEMS.	Quantities (Cubic Yards).	PRICES.		
		Maximum per Cubic Yard.	Minimum per Cubic Yard.	Average per Cubic Yard.
Earth excavation,	267,300	$1 00	$0 25	$0 46
Rock excavation,	100,000	4 00	90	1 16
Rubble stone masonry,	265,000	4 80	3 80	3 99
Ashlar masonry,	10,300	13 50	12 00	12 44
Dimension stone masonry, exclusive of face cutting,	2,900	20 00	16 50	17 47
Brick masonry,	1,300	15 00	12 00	14 23
Concrete masonry,	8,300	6 50	3 75	6 06
Slope paving,	2,700	6 00	3 25	4 47
Broken stone,	2,300	60	60	60

Eleven bids were received for this work. If the highest bid, in which a clerical error was made, is omitted, the amounts range from $1,603,635 to $2,002,450.

The contractor began work on October 11, with a small force, grading a branch track from the Central Massachusetts Railroad to the dam site. On October 15 he began the excavation at the site of the dam, which, up to this time, had been in progress with a day-labor force under the direction of the department engineer. The contractor continued to work upon this excavation, using the plant previously in use, until November 22, when he stopped excavating, as he did not think it feasible to work to greater depths until additional plant had been installed. No further excavations were made in the bottom until December 24, when the first cableway was put in operation and the material taken out with it. On December 31 the bottom of the excavation was at elevation 238, or about 31 feet below the bed of the river.

From the time of beginning work the contractor has been actively engaged in the construction of the branch track, in installing plant and in stripping the quarry about 1¼ miles from the site of the dam.

Considerable progress has been made upon the foundations of a central power station at the side of the Central Massachusetts Railroad between the dam and the quarry, from which compressed air is to be conveyed in pipes to both the dam and the quarry. It is the intention to put in at this place two double Rand air compressors, which are to be operated by two compound condensing Corliss engines, each of which is rated at 500 horse-power.

At the dam one cableway, having a span of 1,150 feet between head blocks and capable of sustaining weights of about 8 tons, is already in operation, and a second cableway of like dimensions is far advanced toward completion. The cables are suspended from movable wooden towers, those at the southeasterly end, near Boylston Street, being 60 feet high, and those at the other end 90 feet high. The towers are all supported upon wheels running upon a 7-rail track, and can be moved up and down stream about 500 feet.

A 12-inch centrifugal pump has been placed in the deep excavation, and is pumping from a large tank into the large flume, the small pumps already in use raising water from the bottom of the excavation into this tank.

The branch track from the Central Massachusetts Railroad to the dam site has been completed. It is 5,490 feet long, and of standard gage. A siding 650 feet long has also been built at the side of the central power plant. Considerable work has also been done on a track about 3,200 feet long which is to extend from a point on the branch track to the quarry. For a distance of about 800 feet, where this track passes over the highway, the Central Massachusetts Railroad and the low land between the two, a pile bridge is to be constructed, and the piles for this bridge have been delivered. A store house, office and other buildings have been erected. The maximum force employed by the contractor has been 163 men and 24 horses.

CLINTON SEWERAGE.

During the year a second 44-inch fire box boiler, which had been in use at the North Dike in connection with the driving of the sheet piling, has been installed in the pumping station, and has been covered with asbestos and magnesia by S. C. Nightingale & Childs.

At the filter-beds 1,010 feet of 6-inch and 8-inch underdrains have been laid under beds where underdrains had been omitted at the time of the original construction, until it should be determined by actual trial whether they were needed.

DRAINAGE OF SWAMPS.

The construction of ditches for the drainage of swamps, which has been described in the last two reports, was continued during the first half of 1900, mainly upon the Wachusett watershed.

During 1899 Brigham's Pond, situated on a tributary of the open channel of the Wachusett Aqueduct, having an area of 14 acres and a depth of 2½ feet, was drained, but it was impossible at the time to finish the improvement, on account of the very deep soft mud in the bottom of the pond. Between January 15 and February 6, 1900, advantage was taken of the support furnished by the frozen mud to build an additional 1,793 feet of ditch in the bed of the pond.

No further work was done on swamp improvement until March 27, when a force began on repairs and miscellaneous work along the ditches which had been built during the previous year, and to build fences along several of the ditches. On May 16 the construction of additional ditches in swamps upon the Wachusett watershed was begun and continued until July 7, when the force engaged upon this work was transferred to the Wachusett Dam.

The swamp improvement made under the direction of the Dam and Aqueduct Department, to the end of 1900, includes swamps in the Sudbury watershed, having an aggregate area of 667 acres, in which ditches having an aggregate length of 82,099 feet, equal to 15.55 miles, have been constructed; and swamps in the Wachusett watershed, having an aggregate area of 132 acres, in which ditches having an aggregate length of 15,048 feet, equal to 2.85 miles, have been constructed.

In addition to the swamps on the Wachusett watershed which have been drained, 21 swamps, having an aggregate area of 734 acres, have been surveyed.

Observations of the color of the water issuing from the ditches at Crane Swamp and from swamps near the New York, New Haven & Hartford Railroad, about one mile southwest from Marlborough Junction, have been made monthly during the year 1900. Similar observations of the color of the water issuing from these swamps were made in 1894–95, before any ditching was done, and a comparison of the results of these observations is given in the following table: —

Color of Water from Crane Swamp and from Swamp Southwest of Marlborough Junction before and after Draining.

[Platinum Standard.]

	Crane Swamp.		Swamp Southwest of Marlborough Junction.	
	Before Draining. 1894-95.	After Draining. 1900.	Before Draining. 1894-95.	After Draining. 1900.
January,	1.90	0.90	1.22	0.55
February,	2.20	1.40	1.65	0.75
March,	1.40	0.75	1.14	0.35
April,	1.54	0.90	1.28	0.60
May,	3.40	0.40	2.28	0.40
June,	2.48	0.65	2.00	0.45
July,	1.95	0.47	1.28	0.40
August,	3.15	0.30	2.00	0.35
September,	1.79	*–	1.48	*–
October,	2.68	0.65	0.90	0.50
November,	2.30	1.05	0.98	0.25
December,	2.00	1.55	1.14	0.55
Average, omitting September,	2.27	0.82	1.44	0.47

* No water running in brook.

FRESHETS.

In the spring of 1900 there were two very large freshets on the Nashua River. The first one occurred on February 13, and was larger than any previous one of which information could be obtained. The maximum flow, after taking into account the loss or gain of storage above the temporary dam, was about 9,050 cubic feet per second, which corresponds to a rate of 2.83 watershed inches in twenty-four hours, at a point about 1.65 miles below the site of the Wachusett Dam. At the point of measurement the area of the watershed is 119 square miles. The flood increased and decreased very rapidly from the maximum, which lasted only about two hours. The total for the twenty-four hours of highest flow was 4,130,000,000 gallons, or at the rate of 6,390 cubic feet per second.

The conditions which caused this freshet were exceptional; three days previous to the beginning of the rain which caused the freshet there had been a cold northeasterly rain, with a precipitation of 1.10 inches, much of which turned to ice as soon as it reached the ground. The rain which caused the freshet began at 6 A.M. February 12, when only the ordinary quantity of water was flowing in the river, and ended at 7 P.M. February 13. The rainfall, as observed at four points on the watershed, ranged from 3.12 inches to 3.31 inches, and averaged 3.18 inches.

The second freshet occurred on March 2, and reached a maximum flow of 7,840 cubic feet per second, which corresponds to a rate of 2.45 watershed inches in twenty-four hours. The total for the twenty-four hours of highest flow was 3,660,000,000 gallons, or at the rate of 5,660 cubic feet per second.

The freshet was caused by a rainfall of about 3.18 inches which fell in thirty-four hours.

The passage of the water of these freshets through the large flume produced some conditions which are unusual and were unexpected. The flume is 40 feet wide, 16 feet in height at the upper end and 13 feet in height at the lower end. It is lined with planed planks, so that it presents a very smooth surface for the passage of water. The total length of the flume is 700 feet, and rather more than half way down from the upper end there is a bend of about 8½ degrees. The flume was built to carry a flow of about 9,000 cubic feet per second. When carrying this quantity it was expected that the loss of head at entrance would be about 4 feet, the depth of water in the upper portion of the flume about 15 feet and the depth at the lower end less than 13 feet. At times during the freshet, after the controlling stop-planks and other works had been nearly removed, the depths of water in the different parts of the flume were about as was expected, but at other times there was a much greater loss of head at entrance, at times as high as 13 feet; and the water, having acquired a very high velocity, as a result of the great fall in the water as it entered the flume, occupied only a comparatively small depth in the up-stream half of the flume, and then ran uphill with an increasing area and diminishing velocity to the outlet. At one time the depth in the up-stream half of the flume was from 6 to 6½ feet, and the velocity in this portion of the flume, as determined by floats about 5 feet in length, was as high as 26 feet per second. In the down-stream half of the flume, where the surface of the water had an upward inclination, it was about 3½ feet higher near the outlet of the flume than in the up-stream half.

At the time of these floods work upon the excavations for the main dam was not in progress, and the down-stream protective dam had not been built; consequently, the water outside of the flume stood at a level with the water at its outlet, and, as the water inside the flume was for a large part of the length at a considerably lower level than that outside, there was a strong tendency for the flume to rise from its foundations. This tendency had been foreseen to some extent, and the flume had been fastened to its foundations for the whole length. Where supported by piling, it was fastened to the piles; where supported upon posts resting upon the ledge, it was fastened to the posts, and the posts in turn were fastened to bolts in the rock which had been tested by a pull of several tons each. Where the foundation was upon earth, planks about 4 feet in length, having triangular pieces nailed to their lower ends, were spiked in a vertical position to the sills, and the holes dug in the ground to receive them were filled with stone and earth. The fastenings proved in many cases to have insufficient strength to resist the upward pressures, and the flume was consequently lifted in many places, requiring that it be replaced in order to make it safe for future operations. Except for the lifting of the flume from its supports, it received very little injury, and successfully carried the water of both freshets. At the time of the first freshet the water at times slopped over the side of the flume.

WESTON AQUEDUCT.

The surveys and studies for this aqueduct were under the charge of the engineer of the Dam and Aqueduct Department until September 24, when a new department was created. For convenience, however, all of this branch of the work will be included in this report under the head of the Weston Aqueduct Department.

REAL ESTATE, CARE AND DISPOSAL.

Rents have been collected and repairs made on the houses belonging to the Board in the neighborhood of the dam and of the sewerage filter-beds in Lancaster. In order to supply water from the town water supply to the houses near the filter-beds, the pipe in the street has been extended for a distance of 2,075 feet with 6-inch and 4-inch cast-iron pipe, and the connections have been made from this pipe to the houses.

ENGINEERING AND MISCELLANEOUS.

Disposal of Sewage from the Quinepoxet Valley.

During 1898 surveys and studies were made to determine the best methods of taking care of the manufacturing wastes and the sewage of small manufacturing villages in the Quinepoxet valley. These studies were not finished at that time, and have been continued by a small party through a portion of 1900. The studies have been made for the purpose of determining what sources of pollution exist at present or are liable to exist in the future, and the best method of taking care of them, whether by separate treatment or the construction of an intercepting sewer in the valley, with suitable disposal works at its lower end. During the year four areas for filter-beds have been carefully examined, contour plans made of them, and 14 test pits, having an aggregate depth of 99 feet, have been dug. Thirteen test pits, having an aggregate depth of 77 feet, have also been dug at other possible areas. A main line of sewer has been located from Quinepoxet Village to the site of filter-beds near the reservoir, and a branch line has been run to Jeffersonville. The total length of the line located is 53,948 feet, or about 10¼ miles.

Relocation of Central Massachusetts Railroad.

A few additional surveys and estimates for the relocation of this railroad were made in the early part of the year. Eight wash drill borings, having an aggregate depth of 315 feet, have been made, to determine the character of the material to be excavated in some of the deep excavations.

Cement Tests.

The usual tables of cement tests are published in Appendix No. 3. They contain a larger number of long-time tests than the tables published in the last report.

SUDBURY DEPARTMENT.

DESMOND FITZGERALD, *Department Engineer.*

The work of construction in this department during the year has been connected principally with the improvement of the Marlborough Brook filter-beds and the drainage of a number of small swamps. These works relate to the improvement of the quality of the water in that portion of the Sudbury River watershed above Framingham Dam No. 3. The grading and planting of the grounds below the Sudbury Dam, in connection with the moving of the building formerly used for an office, have been continued and completed.

The engineering force has gradually diminished as the work of construction has been finished. At the beginning of the year the force numbered 12, and at the end of the year 1. Edward S. Larned has remained in direct charge of all of the work of construction until his transfer to the Weston Aqueduct Department at the close of the year. Charles W. Sherman, assistant engineer, is Mr. FitzGerald's principal assistant in the Boston office. Walter W. Patch, Benjamin F. Goodnough and William Smiddy, assistant engineers, have been transferred to maintenance. Almon A. Platts, assistant engineer, was suspended July 21, on account of the completion of the work upon which he was engaged. Fred. F. Moore, draftsman, resigned his position on October 8, to accept work elsewhere.

MARLBOROUGH BROOK FILTER-BEDS.

These beds were built during the working season of 1899, and put into use the succeeding winter. Their construction was described in the last report.

The operation of the beds during the winter showed that it would be desirable to enlarge the main channel to the filter-beds and to provide more storage for the very large flows from the steep and impervious watershed of the brook. Under the ordinary conditions attending the filtration of water, there is uniformity in the amount of water to be filtered from day to day; but in the present instance an extremely small flow is sometimes followed in the course of a few hours by a flood. Under these circumstances the surfaces of the beds have ample opportunity to freeze, and when there is a sudden flood it becomes necessary to store a large amount of water in a short time, to prevent the unfiltered water from overflowing into the reservoir. The flood waters are discharged from the watershed with a greater degree of concentration than was anticipated, and, as a consequence, the main channel leading to the beds was too small to convey the water to them as rapidly as furnished by the brook. The channel was widened to 14 feet at its upper end, giving it a capacity of 120 cubic feet per second, even when the ice has accumulated upon the bottom and sides to a depth of 10 inches. This capacity is equivalent to 2.5 watershed inches in twenty-four hours, on 1.8 square miles of watershed.

In addition to the storage originally provided by one storage bed and the filter-beds, a further storage of about 5,000,000 gallons was provided by utilizing two areas lying between some of the natural filter-beds.

Besides the above work, the controlling dams in the main channel were enlarged and six additional inlets to the beds were provided. A spillway to prevent the overflowing of the embankments was also constructed at the lower end of bed No. 25 of the natural filter-bed system. The exterior slopes of the embankments connected with the natural filter-beds for 3,446 feet in length were thoroughly protected with 12 inches of coarse gravel, and for 900 feet in length near the Framingham Road were covered with loam.

As it was found difficult to clean the natural beds, on account of the presence of a large number of gravel stones, their surfaces were harrowed two or three times, and the stones removed between the operations. These stones were used to face the inside slopes of the embankments to a depth of about 6 inches, for the purpose of protection against damage by wave action.

In addition to the foregoing work, the embankments connected with the artificial beds were put in good order and seeded, and the surfaces of the beds thoroughly cleaned. As some difficulty had been found in winter from the adhesion to the sand of the ice which had formed on the surface of the water, cobble stones were placed upon the beds at intervals of about 4 feet, to prevent the ice from resting directly on the beds when the water lowered. A similar treatment has been applied to large portions of the surfaces of the natural beds.

Drainage of Swamps.

The work of draining the swamps directly tributary to the Sudbury Reservoir and Framingham Reservoir No. 3 has been continued during a considerable portion of the year.

The work in Deerfoot Swamp, which was under way at the date of the last report, was entirely completed January 17, making an addition of 2,776 feet of ditch in that swamp.

On August 28 work was begun in the swamps existing on Mowry and Broad Meadow brooks, tributary to the Sudbury Reservoir, and on December 8 the work was completed. It involved the construction of 24,333 feet of timbered and riprapped ditch, almost equally divided between meadow and woodland. The work also included the rebuilding of several culverts at road crossings, together with bridges and watering places for the convenience of land owners.

The following table shows the cost of all the swamp work executed to date under the direction of this department, exclusive of engineering: —

LOCATION.	Timbered Ditch (Feet).	Total Cost.	Cost per Foot.
Angelico Brook,	9,702	$3,904 83	$0.402
Brewer Brook,	5,500	3,343 59	.244
Deerfoot Brook,	7,876	2,449 61	.311
Mowry and Broad Meadow brooks,	24,333	5,717 76	.235
Total,	47,411=8.98 miles.	$13,415 79	-
Average,	-	-	$0.283

Besides the above, about 2,500 feet of original brook courses were cleaned out and deepened, the cost of which is included in the above table.

The amount paid for land damages to secure the right to construct these ditches was $49.82. The total area of swamps drained was 270 acres, with a watershed of 2,933 acres.

The swamp improvement upon the portion of the Sudbury watershed above Framingham Dam No. 3 is now substantially completed, and the total amount of work done by both the Dam and Aqueduct and Sudbury departments is as follows: —

	Acres of Swamp Drained	Length of Ditches.	
		Feet.	Miles.
Dam and Aqueduct Department,	667	82,099	15.55
Sudbury Department,	270	47,411	8.98
Total,	937	129,510	24.53

Store House, Sudbury Dam.

A masonry store house 19 by 30 feet, inside dimensions, has been constructed by day labor at the northerly end of the Sudbury Dam, for the storage of stop-planks, boats, tools and coal. As the structure is built principally below the surface of the ground, the foundations and walls were entirely surrounded by broken stone and screened gravel, underdrained by a 3-inch drain.

Engineering.

The work of the engineering force during the year has been principally in connection with the works above described. In addition, however, surveys and plans have been made for the drainage of several smaller swamps on the Sudbury River watershed, which work has not been carried out, either because it was thought unadvisable, or because it was impossible to secure the consent of the land owners. The tabulation of the cost of the water works taken from the city of Boston has been continued during the greater portion of the year, and was nearly completed when a settlement was made with the city. A portion of the time of the engineers has been given to the preparation of testimony in damage cases connected with the taking of the water of the Nashua River.

WESTON AQUEDUCT DEPARTMENT.

HORACE ROPES, *Department Engineer.*

In last year's report reference was made to the surveys in progress for a new aqueduct from the Sudbury Reservoir to the Metropolitan District, which has since been called the Weston Aqueduct. A small party was engaged upon this work at the beginning of the year, under the charge of Mr. Richardson, engineer of the Dam and Aqueduct Department, with George W. Booth, assistant engineer, in charge of the party. On July 25, a party of three engineers, under the charge of Marshall Nevers, assistant engineer, was transferred to the Weston Aqueduct, to establish precise benches as a basis for future levels. On September 24 the work upon this aqueduct to the lower end of the masonry structure was placed under the charge of Horace Ropes, as department engineer, with a view to preparing portions of the work for letting in the spring of 1901, and the force was further increased from time to time by transfers from other departments.

Daniel W. Cole, assistant engineer, was connected with this work from September 24 until November 8, when he resigned to accept another position. F. E. Winsor, assistant engineer, was placed in charge of the office work on October 16. Dan B. Clark, assistant engineer, was placed in charge of a field party on November 15.

The main office of the department was established at Saxonville, on the street leading to South Framingham, in a house leased from the Saxonville Mills. The branch office established at Weston in 1899 has been continued throughout the year.

The engineering force at the beginning of the year numbered 6; just before the appointment of Mr. Ropes the force numbered 9, and at the end of the year it had increased to 20. During the latter part of the year a force of wood choppers was engaged in clearing the wood from the site of the Weston Reservoir.

The precise location of the aqueduct has not been determined in all places, but it is expected that it will be substantially as follows: starting from the Sudbury Reservoir, a masonry aqueduct, having a capacity of 300,000,000 gallons per day, will be built in Southborough, Framingham, Wayland and Weston, to the high land west of the Charles River, about one-half mile north of the Boston &

Albany Railroad. On the line of this aqueduct, north of Saxonville, in the town of Framingham, the valley of the Sudbury River is to be crossed by pipes. West of the Sudbury River there will be three tunnels on the line, having a total length of about 5,850 feet. In the town of Weston there will be two tunnels, having lengths of about 5,600 and 500 feet; and an equalizing reservoir, to be known as the Weston Reservoir. The aqueduct will be omitted for the distance occupied by this reservoir.

The total distance from the Sudbury Dam to the lower terminus of the masonry aqueduct will be about 13.4 miles. For the remainder of the distance to the main pipe system of the Metropolitan Water District the ground is not high enough to permit the construction of a masonry aqueduct, and pipes which will convey the water under pressure will be required. Surveys have been begun by engineers of the distribution department, to determine the best location for these pipes. The end of the masonry aqueduct in Weston will be 65 feet higher than Chestnut Hill Reservoir and 36 feet higher than Spot Pond, so that it will be feasible to supply water by gravity from the aqueduct to the low-service district and to Spot Pond.

The surveys during the year have related to the determination of the most economical route, the establishing of precise benches, the studies for necessary grade changes in highways, the collection of such information as is necessary for designing culverts, the determination by rod soundings of the amount of ledge rock to be encountered, and the determination of the character of the material in a few instances by wash drill borings. In addition to this work, property lines have been located all along the line of the aqueduct, and particularly at the Weston Reservoir, where nearly all of the land required for the reservoir has been purchased.

Nine hundred and eight rod soundings were made in 1900, having an aggregate depth of 8,827 feet, making a total of 1,677 soundings, having an aggregate depth of 16,163 feet, on the lines which have been run for the aqueduct. In addition, 109 rod soundings, having an aggregate depth of 427 feet, have been made to determine the elevation of the surface of the ledge at the dam of the Weston Reservoir. Ten wash drill borings, having an aggregate depth of 278 feet, were made in 1900 to determine the character of the material at the tunnel near the Sudbury Dam, and the character of the material at a mud hole east of the New York, New Haven & Hartford Railroad in Framingham. One hundred and sixty-five shallow test pits were dug at the site of the Weston Reservoir, to determine the depth of stripping required.

DISTRIBUTION DEPARTMENT.

DEXTER BRACKETT, *Department Engineer.*

The work in charge of this department comprises the pipes, distributing reservoirs, pumping stations and all other works in the Metropolitan District, with the exception of Chestnut Hill Reservoir and the grounds about it, and the Sudbury and Cochituate aqueducts.

During the year the work of improving and raising Spot Pond has been completed. The buildings and machinery at the new pumping stations at Chestnut Hill Reservoir and Spot Pond are so nearly finished that the machinery has been placed in service. The gate-chamber at Chestnut Hill Reservoir has been completed. A reservoir and standpipe on Forbes Hill, in Quincy, for the storage of a reserve supply for that city, has been under construction during the latter part of the year, and the standpipe has been placed in service, although the masonry tower which will enclose it has not yet been built. The laying of pipes connecting the pumps at the new low-service pumping station at Chestnut Hill with the mains of the Boston Water Department has been finished.

The organization of the engineering force has remained nearly the same as during the previous year, but the number of men employed has been somewhat less.

William E. Foss, John L. Howard and Caleb M. Saville have continued in charge of the engineering work, in connection with the construction of reservoirs, pumping stations and pipe lines.

Alfred O. Doane has had charge of records of water consumption, the installation and operation of regulating valves, pressure gages and Venturi meters in various portions of the District, and has also superintended many of the details connected with the maintenance of the works.

George E. Wilde, assistant superintendent, has continued in charge of the maintenance and operation of the pipe lines, reservoirs and other works within the Metropolitan District, with the exception of the pumping stations, and has, with the force under his charge, done nearly all of the pipe laying which has been done during the year.

The engineering force at the beginning of the year was 53, and gradually decreased from that time, until the end of the year, when it numbered 32.

Pipe Yards.

The new buildings at the Glenwood pipe yard were completed by W. L. Clark & Co. on March 1, and were occupied as the headquarters of the assistant superintendent on May 1. A building 20 by 12 feet, for the storage of oils and paints, and a shed 35 by 20 feet, for the protection of valves, etc., have been erected at this yard during the year.

The portion of the grounds at Chestnut Hill which is to be used for a pipe yard has been graded, the office, carpenter's shop, store house and shed moved to permanent locations and repainted, and a derrick erected for handling the pipes.

In February the valves and nearly all of the special castings were removed from the yard at Forest Hills, the pipes repiled so as to occupy less room, and the derrick and office building were removed.

At the Brighton yard only one man has been regularly employed. The stock stored there has been gradually reduced by use or by removal to the yards at Glenwood and Chestnut Hill, and the use of the premises will soon be abandoned.

Pipe Laying.

The only extensions of importance made to the pipe system during the year have been the 48-inch pipes connecting the low-service pumping station at Chestnut Hill with the 48-inch pipes of the city of Boston near the old effluent gate-house, and 827 feet of 12-inch pipe laid in the city of Lynn for an additional connection with the pipes of the town of Swampscott. All of this work has been done by the maintenance force.

At Chestnut Hill 1,200 feet of 48-inch pipe and 303 feet of 36-inch pipe were laid, connections made with three new engines at the low-service station and with two 48-inch mains of the city of Boston, including the setting of eight 36-inch valves and two Venturi meters. This work was completed early in August.

During the year connections have been made with the pipe systems of cities and towns in the Metropolitan District as follows: Pleasant

Street, at the junction of Commercial Street in Malden, for fire service only; Ward Street, near Hammond Street, Newton; Adams Street, at junction of Randolph Avenue, Milton; Adams Street, near the East Milton station, Milton. The valves on the connections in Newton and Milton remain closed.

SPOT POND.

At the close of the year 1899 the work of raising and improving this pond, which was begun early in that year, was well advanced toward completion. The drainage system was completed, the concrete masonry for the core walls of the dams and for the gate-houses and the inlet conduits was finished, and about 60 per cent. of the earthwork was done. Considerable work was done on sections 2, 3 and 4 during the months of January, February and March, in excavating mud and sand and in riprapping slopes. As soon as the frost left the ground all parts of the work were actively pushed, and on August 15 the work was so nearly completed that the refilling of the pond by pumping from Chestnut Hill was begun. The loaming of embankments and cleaning up grounds occupied the contractors until September 19, when all contract work was finished. The seeding and planting of trees and shrubs on newly filled areas was done by the maintenance force after the contract work was finished.

A detailed description of the several sections into which the work about the pond was divided was given in the last annual report.

The greater portion of the work on Section 1 was finished in 1899. During the months of April and May, 1900, a force of about 50 men and 24 horses was employed in loaming embankments, surfacing roadways and riprapping slopes, and the contractor's work was finished on June 9.

On Section 2, Moulton & O'Mahoney continued work until February 1, resumed operations about April 1, and practically finished the work early in June.

About one-third of the work on Section 3 was completed on January 1, 1900. During January and February the Newell & Snowling Construction Company employed about 75 men on the work, and moved about 900 cubic yards of earth per day. Operations were suspended from March 1 to 20, on account of severe weather. From April until September 1, when the contract was completed, a force of from 80 to 150 men was employed. On this section a trench

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about 1,000 feet in length was excavated through the coarse sand and gravel to fine sand, and then refilled with fine sand and mud taken from the bottom of the pond. At two points this trench was carried down about 34 feet below the new high-water level of the pond.

Moulton & O'Mahoney, contractors for Section 4, continued work through the winter, and as soon as the weather was favorable increased their force to nearly 200 men. The work on this section was finished about September 15.

Section 5 was completed in 1899.

On Section 6, P. H. Fitzgerald, the contractor for the earthwork and also for the concrete masonry gate-chamber and conduit, completed the greater part of the work called for by his contract in 1899. He suspended operations on January 15, resumed work March 20, and continued with a force of from 40 to 100 men until July 13, when the work was finished, including the building of a new road about 1,610 feet long from Woodland Road to the gate-chamber at the southern inlet to the pond.

The superstructure of the gate-chamber has been built by John S. Jacobs & Son, from designs furnished by Shepley, Rutan & Coolidge. The building is 18 by 26 feet in exterior dimensions, with walls of gray Roman brick with trimmings of buff Bedford limestone, and a roof of red tile. Two 60-inch hydraulic sluice gates were set in the gate-chamber by the Atlantic Works, and two 60-inch gates for controlling the flow of water from different levels in the pond were furnished and set by the Coffin Valve Company.

A contract for the work on Section 7 was made with the Newell & Snowling Construction Company on May 26. The work, comprising the stripping of the eastern shore for a distance of 3,600 feet and the grading about the pumping station, was begun May 28 and completed August 15.

The superstructure of the gate-house on the easterly shore of the pond near the pumping station was completed early in the year. This building was built by McNeil Bros., at a cost of $2,600. It is 21 feet 8 inches by 13 feet 8 inches inside, with exterior walls of Indiana limestone and a roof of red tile. The interior walls are of red pressed brick.

In addition to the work which has been done by contract, there has been considerable work done by the regular force, employed in the maintenance department, in laying drains, building fences, seeding newly graded areas, riprapping slopes and planting trees and shrubs. In connection with this work, 4,175 linear feet of vitrified pipe and 808 feet of cast-iron pipe were laid, 38 catch-basins and 3 valve chambers built, about 45 acres of ground covered with fertilizer and seeded, 1,455 feet of fence built and 496 cubic yards of riprap placed on the shore at points where waves had washed the beaches.

During the year the brick building formerly used by the town of Melrose as a pumping station, and the house adjoining, used as a residence for the engineer, have been torn down; also a stone building near the shore of the pond on the Wheildon estate; the old McGeoch house, which had been used as an office by the engineering force while the work at the pond was in progress; and the house and barn on the Ames place, near the headquarters of the Metropolitan Park Department.

The following table shows the principal items, quantities and cost of the work done in connection with the raising and improvement of Spot Pond: —

	Quantities.	Cost per Unit.	Total Cost.	
Cleaning and improving Pond.				
Wash borings, soundings, test pits, ...	-	-	$5,639 30	
Clearing (acres), ...	80	$101 25	8,100 00	
Ditching, burning peat, cleaning Spot Pond Brook, .	-	-	3,400 00	
Earth excavation (cubic yards), ...	1,036,763	0 29	299,638 54	
Rock excavation, including masonry walls (cubic yards),	2,887.8	1 45	4,184 79	
Riprap (cubic yards), ...	28,128.6	1 13	31,887 57	
Portland cement concrete core walls of dams (cubic yards).	1,951.9	7 44	14,513 20	
American natural cement concrete core walls of dams (cubic yards).	1,799	5 54	9,961 02	
Plastering core walls of dams (square yards), . . .	3,636	0 44	1,585 69	
Temporary bridges to reach islands, ...	-	-	847 21	
Weeding, seeding, fertilizing and miscellaneous work, .	-	-	5,984 92	
Tree planting, ...	-	-	1,786 00	$387,528 24
Drainage System.				
Earth excavation (cubic yards), ...	17,516	$0 56	$9,738 90	
Rock excavation (cubic yards), ...	687	2 50	1,718 25	
Amounts carried forward, ...	. . .	. .	$11,457 15	$387,528 24

	Quantities.	Cost per Unit.	Total Cost.	
Amounts brought forward,	. . .	. .	$11,457 15	$387,528 24
Drainage System — Concluded.				
30-inch cast-iron pipe and laying (feet),	2,400.9	4 59	11,021 50	
24-inch vitrified pipe and laying (feet),	1,617.7	1 06	1,714 76	
Stone paving (square yards),	2,076.9	1 00	2,076 90	
Portland cement concrete (cubic yards),	645.6	7 50	4,842 00	
Brick masonry (cubic yards),	38.5	14 00	539 00	
Sluice valves and ironwork,	-	-	1,282 55	
Spruce lumber in place (M feet B. M.),	33	35 00	1,155 00	
Underdrains, catch-basins, drains, etc.,	-	-	3,834 31	37,923 17
Gate-chambers and Inlets.				
Coffer-dam,	-	-	$6,000 00	
Earth excavation (cubic yards),	6,040	$0 55	3,319 75	
Rock excavation (cubic yards),	1,632	2 03	3,318 53	
Stone paving (cubic yards),	133.1	1 42	188 58	
Portland cement concrete (cubic yards),	2,528.5	8 04	20,340 84	
Dimension stone masonry (cubic yards),	13.1	22 20	290 80	
Superstructures,	-	-	7,000 00	
Sluice gates,	-	-	7,673 23	
Ironwork,	-	-	2,261 92	
Miscellaneous,	-	-	3,224 61	53,618 26
Police,	-	-	$2,841 75	
Advertising and miscellaneous,	-	-	1,614 38	4,456 13
Real estate,	-	-	-	57,948 56
Total cost, exclusive of engineering,	. . .	. .	. .	$541,474 36

Southern High-service Pumping Station.

The 30,000,000-gallon engine, built by the E. P. Allis Company of Milwaukee, Wis., was used in regular service during the greater part of the year 1899, but the official trial of the engine was not made until May 1, 1900.

The following statement, condensed from the official report of the trial, has been prepared by Mr. Brackett, and gives the most important figures regarding the engine and the results obtained: —

The engine is of the vertical, triple expansion, self-contained type, with three single-acting, outside-packed plungers, which are placed directly under the steam cylinders and rigidly connected with the steam pistons. The inlet and exhaust valves for the high-pressure cylinder and the inlet valves for the intermediate cylinder are of the Corliss type; the exhaust valves for the intermediate cylinder and the inlet and exhaust valves for the low-pressure cylinder are of the poppet type. The cut-off on the high-pressure cylinder is controlled by an automatic centrifugal governor, and is also adjustable by hand. On the intermediate cylinder the cut-off is adjustable by hand, and on the low-pressure cylinder the cut-off is fixed. The cylinders are jacketed on the barrels. All valves are placed in the cylinder heads. There are receivers fitted with copper reheating coils between the high-pressure and intermediate cylinders, and between the intermediate and low-pressure cylinders. The steam from the low-pressure cylinder passes through an exhaust heater containing 300 square feet of surface to a surface condenser containing 2,000 square feet of cooling surface, and the circulating water for the condenser is taken from and returned to the suction main. The air pump, boiler feed pump and air compressor for charging the discharge air chambers are attached to and driven by the main engine.

Each pump is composed of five principal castings. They are located at right angles to the longitudinal centre line of the engine. On one side there is a suction valve chamber and on top of this a suction air chamber. On the opposite side there is a discharge valve chamber and on top of this a discharge air chamber. The suction and discharge valve chambers are connected by the plunger chamber. The suction, discharge and plunger chambers rest on and are bolted to a masonry foundation, and the engine bed plate rests on and is bolted to the top of the suction and discharge air chambers, thus forming a self-contained structure.

The three pumps are connected longitudinally by the suction pipe on one side and the discharge pipe on the other. The pump valves are 5/8 of an inch thick, and made of the best grade of medium rubber. The valve seats are made of composition, and are mounted in groups of 35, on cages which can be easily removed from the chambers. The free water way through each set of suction and discharge valve seats is 121 per cent. of the area of the plunger.

Steam was furnished by a double furnace Belpaire boiler, designed by E. D. Leavitt, M.E., of Cambridge, and built by the Lake Erie

Boiler Works of Buffalo, N. Y. Each furnace is equipped with a mechanical stoker, made by the American Stoker Company of New York, and a forced draft for the stokers is supplied by a blower outfit which was installed by B. F. Sturtevant of Boston. The escaping gases pass from the boiler around the tubes of a Green economizer, built and erected by the Fuel Economizer Company of Matteawan, N. Y. The feed water is pumped through the tubes of the economizer on its way to the boiler.

Method of Conducting Trial.

The contract provided that the engine should perform a duty of 150,000,000 foot-pounds for each 1,000 pounds of commercially dry steam used by the engine and any auxiliary pumps supplied by the contractor, steam containing less than 1½ per cent. of entrained water, as determined by calorimeter measurement, to be considered as commercially dry steam, the work performed by the engine to be based upon plunger displacement.

As the contract requirement for duty was based upon the quantity of steam used by the engine, great care was taken to accurately determine the amount used. All connections between the boilers which supplied steam to the engine and the other boilers in the station were either broken or closed with blank flanges. A few days before the trial a twenty-four hour test was made, to determine the leakage from the boiler and steam piping. During the trial all water fed into the boiler, and all condensed steam from the engine, cylinders and jackets, receiver coils and separator, were carefully weighed.

As the contract requirement for duty was based upon steam consumption and not upon the amount of coal used, it was not deemed advisable to attempt to begin the test with a new fire under the boiler, or to draw the fire at the close of the trial. Fires were cleaned about two hours before the test began, and once during the twenty-four hours, which is the regular practice in operating the station. The condition of the fires at the beginning and at the end of the test was as nearly the same as could be determined by the careful inspection of three persons; and, as the quantity of coal fed to the boiler during the last four hours was above the average during the remaining portion of the time, it is thought that the recorded weight very closely represents the actual quantity burned during the twenty-four hours. All steam used by the mechanical stokers and the blower and economizer engines during the trial was supplied by a separate boiler, and in determining the duty of the engine on a coal basis an addition of 800 pounds was made to the quantity of coal actually burned, this amount being determined by subsequent test.

The coal used during the trial was the Loyal Hanna, Sonman Shaft run of the mine coal in regular use at the station.

Principal Dimensions of Engine.

1.	Diameter H. P. cylinder (nominal),	30 inches.
2.	Diameter I. P. cylinder (nominal),	56 "
3.	Diameter L. P. cylinder (nominal),	87 "
	Cylinder clearances: —	
4.	High pressure,	1.35 per cent.
5.	Intermediate pressure,	.55 "
6.	Low pressure,	.45 "
7.	Diameter of plungers (nominal),	42 inches.
8.	Stroke of pistons and plungers (nominal),	66 "
9.	Diameter suction and discharge pipes,	48 "
10.	Diameter fly-wheels (2),	20 feet.
11.	Weight of each wheel,	50,000 pounds.
12.	Revolutions per minute for capacity,	17.5
13.	Piston speed per minute,	192.5 feet.

Principal Dimensions of Boiler.

14.	Boiler diameter,	90 inches.
15.	Boiler length (over all),	34 feet 4 "
16.	Number of tubes,	201
17.	Diameter of tubes,	3 inches.
18.	Length of tubes,	16 feet.
19.	Heating surface,	2,849 square feet.
20.	Inside area of tubes,	8.49 "
21.	Grate, length (each),*	7 feet.
22.	Grate, width (each),*	4 feet 6.75 inches.
23.	Grate, area (2 furnaces),	63.875 square feet.
24.	Ratio of heating to grate surface,	44.6 to 1
25.	Ratio of grate to inside area of tubes,	7.52 to 1
26.	Economizer heating surface outside of tubes,	1,680 square feet.

Trial Data.

27.	Date of trial, 9.15 A.M., May 1, to 9.15 A.M., May 2, 1900.	
28.	Duration of trial, twenty-four hours.	
29.	Steam at throttle (per square inch),	185.47 pounds.
30.	First receiver (per square inch),	30.85 "

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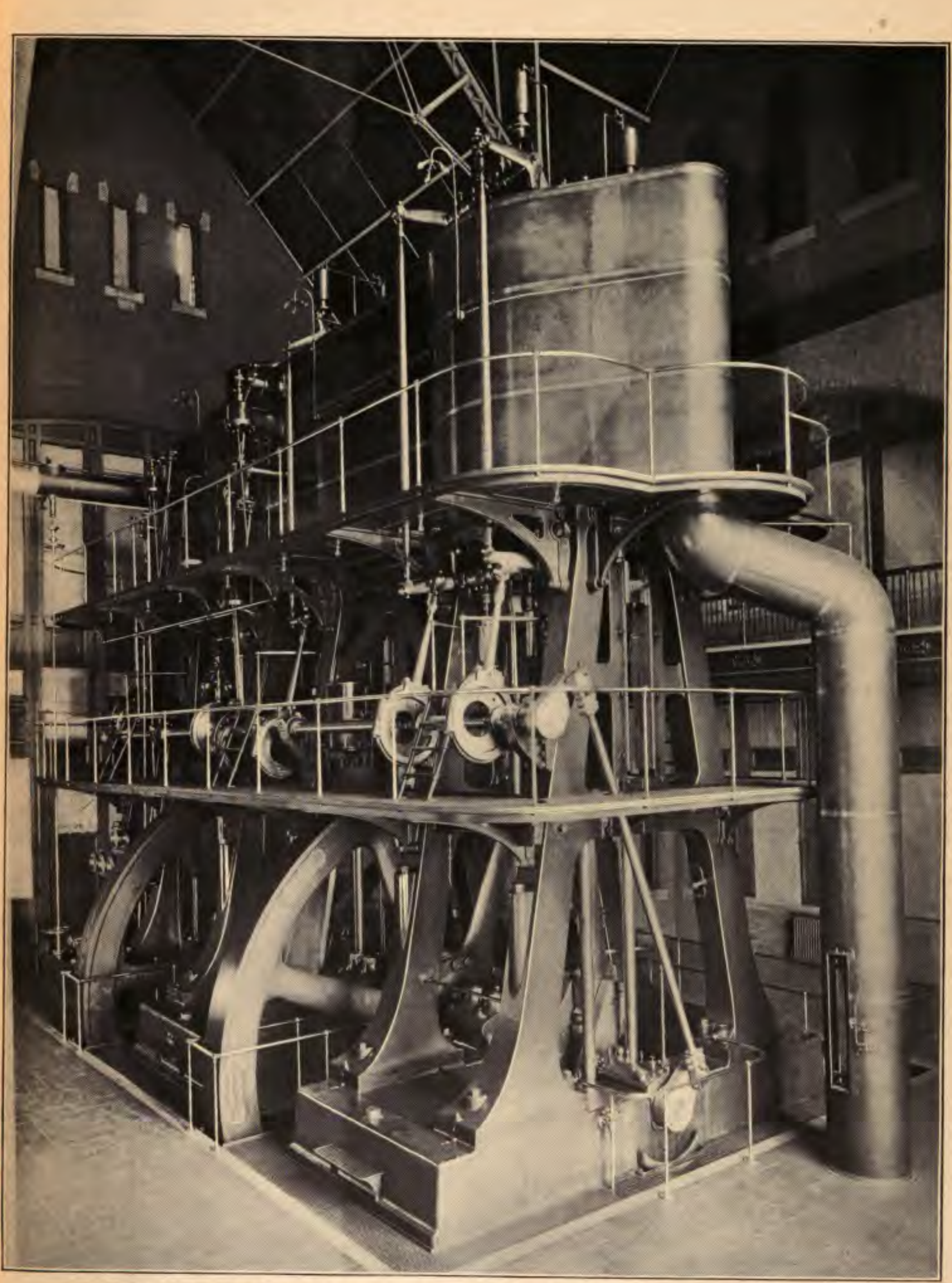
* American mechanical stokers used under boilers with forced draft.



NEW ALLIS PUMPING ENGINE AT CHESTNUT HILL HIGH-SERVICE PUMPING STATION.

31. Second receiver (per square inch),	—3.31	pounds.
32. Vacuum (per square inch),	13.80	“
33. H. P. jacket (per square inch),	185.47	“
34. I. P. jacket (per square inch),	73.40	“
35. L. P. jacket (per square inch),	4.80	“
36. Steam at boiler,	382.95°	Fahrenheit.
37. Steam at throttle,	382.15°	“
38. Steam entering H. P. cylinder,	381.34°	“
39. Steam entering I. P. cylinder,	278.36°	“
40. Steam entering L. P. cylinder,	198.91°	“
41. Steam leaving L. P. cylinder,	116.41°	“
42. Water entering economizer,	79.72°	“
43. Water leaving economizer (fed to boiler),	154.98°	“
44. Flue gases leaving boiler,	485.40°	“
45. Flue gases leaving economizer,	221.90°	“
46. Average elevation above Boston city base, corresponding to pressure of water in force main,	271.856	feet.
47. Average elevation of water in pump-well above Boston city base,	131.506	“
48. Average net head pumped against,	140.350	“
49. Total revolutions during twenty-four hours,	25,539	
50. Average revolutions per minute,	17.7354	
51. Water pumped (no allowance for slip),	30,313,911	U. S. gallons.
52. Total water fed to boiler,	205,370	pounds.
53. Water from separator,	2,019	“
54. Steam blown through calorimeter (weighed in tank),	649	“
55. Leakage from whole plant, exclusive of engine,	1,112.5	“
56. Total steam out of boiler not used by engine,	3,780.5	“
57. Steam from boiler chargeable to engine,	201,589.5	“
58. Steam received from condenser,	170,427	“
59. Steam received from L. P. jacket,	25,886.5	“
60. Steam received from second receiver,	5,276	“
61. Total steam used by engine,	201,589.5	“
62. Average entrainment in steam entering engine,	1.37	per cent.
63. Total dry steam used by engine,	198,827.7	pounds.
64. Total steam used in jackets,	15.45	per cent.
65. Average friction of engine,	6.71	“
66. Average delivered horse-power (useful work),	747.785	horse-power.
67. Average indicated horse-power, H. P. cylinder,	292.057	“
68. Average indicated horse-power, I. P. cylinder,	248.773	“
69. Average indicated horse-power, L. P. cylinder,	260.739	“
70. Total indicated horse-power,	801.569	“
71. Average moist steam per I. H. P. per hour,	10.479	pounds.
72. Average dry steam per I. H. P. per hour,	10.335	“
73. Total coal burned in twenty-four hours,	19,612	“
74. Total coal burned if boiler supplying steam for test had supplied steam to fan, stoker and economizer engines,	20,412	“

75. Evaporation per pound of coal, actual conditions, including economizer,	10.472	pounds.
76. Evaporation per pound of coal, actual conditions, excluding economizer,	9.785	"
77. Evaporation per pound of coal, from and at 212° F., including economizer,	12.478	"
78. Evaporation per pound of coal, from and at 212° F., excluding economizer,	11.660	"
79. Coal per I. H. P. per hour,	1.02	"
80. Duty per 1,000 pounds moist steam, deducting plunger leakage (contract basis),	176,051,500	foot-pounds.
81. Duty per 1,000 pounds dry steam, deducting plunger leakage,	178,497,000	"
82. Duty per 1,000,000 B. T. U.,	157,002,500	"
83. Duty per 100 pounds coal, making allowance for coal required for supplying steam to fan, stoker and economizer engines,	173,869,000	"
84. Efficiency of mechanism,	93.29	per cent.
85. Thermal efficiency of engine,	21.63	"

The following is the amount expended for the addition to the station and for the new machinery, exclusive of the engineering: —

Extension of building, including engine foundation,	$54,212	19
Engine contract, the E. P. Allis Company,	139,561	50
Boiler contract, Lake Erie Boiler Works,	13,650	00
Mechanical stokers, contract, American Stoker Company,	2,760	00
Travelling crane, contract, Brown Hoisting and Conveying Machine Company,	1,930	00
Boiler foundations, steam and water piping, valves, electric wiring, bronze tablet, etc.,	12,258	60
Total,	$224,372	29

LOW-SERVICE PUMPING STATION.

At the beginning of the year the masonry portion of the building was practically finished, but the doors, windows and interior finish had not been placed in position. The pump castings for two of the engines were in place, and two boilers had been delivered at the station but were not erected. During the early part of the year the windows were put in position and glazed, doors hung, iron stairways erected, and the ironwork and woodwork painted or oiled. Drains were also laid under the floors in the basement of the engine room and in the boiler room, and these floors finished with a granolithic surface. At present the only portion of the building unfinished is the slate floor in the engine and dynamo rooms, the material for which is now being delivered.

The castings for one of the engines were delivered in January, for the second engine in March, for the pumps for the third engine about June 1, and for the engine itself in July. The work of erecting the engines and steam piping was pushed along as rapidly as possible, and one engine was started on June 1, the second engine on July 2 and the third on September 27. At the present time all of the engines are practically finished with the exception of painting.

All three of the boilers were in place on January 20, and the erection of the flues and feed piping was finished about March 1. The work of covering the boilers with magnesia was completed about May 1.

Moore & Wyman began the erection of the hydraulic lift for raising ashes from the tunnel under the boilers on March 12, and completed it ready for use on May 22. The engine and dynamo for lighting the building were ready for service on May 24.

The work of wiring the engines and the boiler and coal houses for electric lights has been done by our own employés, under the immediate direction of A. I. Plaisted. The pumping station employés have installed the heating plant for the building, put in position the 36-inch pipes and valves connecting the engines with the equalizer tank, and have done a large amount of miscellaneous piping and other work throughout the building.

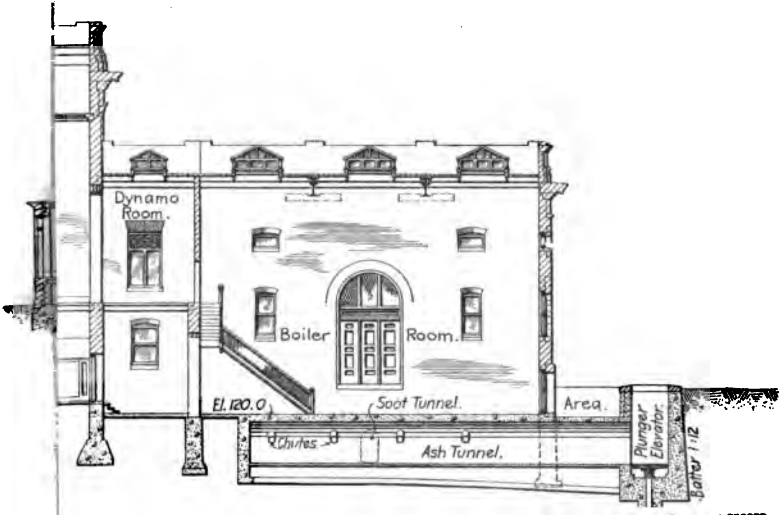
The following is a description of the building and machinery: —

The pumping station, which has been built by Norcross Bros., from designs made by Shepley, Rutan & Coolidge, has front and end exterior walls of buff Bedford Indiana limestone, with a base of pink Milford granite. The rear wall is of brick with limestone trimmings. The building contains an engine room, 134 by 60 feet, 41.5 feet in height from the floor to the under side of the roof trusses; a boiler room, 62 by 40 feet; a coal house, 89.5 by 48 feet; a dynamo room, 38 by 17 feet; and a tower, 19 feet square, in which is located a steel equalizer and overflow tank, 13.5 feet in diameter and 33 feet high, having a capacity of 31,000 gallons. The interior facing of the engine room walls is of buff brick with red brick trimmings, and the floor is to be of green slate tile. The floors in the basement of the engine room and in the boiler and coal houses are of granolithic. Extending nearly the entire length of the engine room at the rear is a low structure 11 feet in width, covering the 'pump-wells and containing eight 40-inch sluice gates, by means of which the flow of water into the pump-wells from the supply conduit is controlled. The chimney is 125 feet high, 13 feet in exterior diameter at the base and 8 feet at the top under the cap. The flue is 4 feet 6 inches in diameter. Above the roof the chimney is faced with gray Roman bricks, to harmonize with the color of the exterior of the building.

The site of the building was formerly a meadow, which was filled with rock debris to depths of from 12 to 16 feet during the construction of the Chestnut Hill Reservoir, and the construction of the foundation walls of the building and for the engines was rendered somewhat difficult and expensive by these conditions. The foundations for the walls of the building, engines, boilers and chimney, and for the pump-wells and their supply conduit, are all of cement concrete, Rosendale cement being generally used for the portion of the building foundation below the level of the lower floors, and Portland cement for the pump-wells and for exposed walls. About 5,200 cubic yards of concrete were used in the building, exclusive of that used in the granolithic floors.

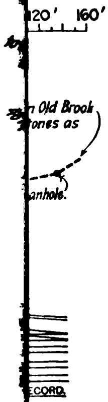
In the engine room the Holly Manufacturing Company of Lockport, N. Y., has erected three 35,000,000-gallon, triple expansion, fly-wheel engines, and at the westerly end of the room space has been reserved for additional machinery in the future. Each engine draws its supply from an independent well, through two 36-inch diameter pipes, and discharges through two 36-inch pipes into the force mains leading toward Spot Pond or Boston. In the basement of the engine house there is a 36-inch valve on each discharge pipe operated by hydraulic power, and each pump is connected with the equalizer or overflow tank in the tower, so that when the pressure on the pumps rises above that due to the elevation of the overflow of the tank, which is 29 feet above the high-water level of Spot Pond, the water overflows from the tank back to the pump-wells.

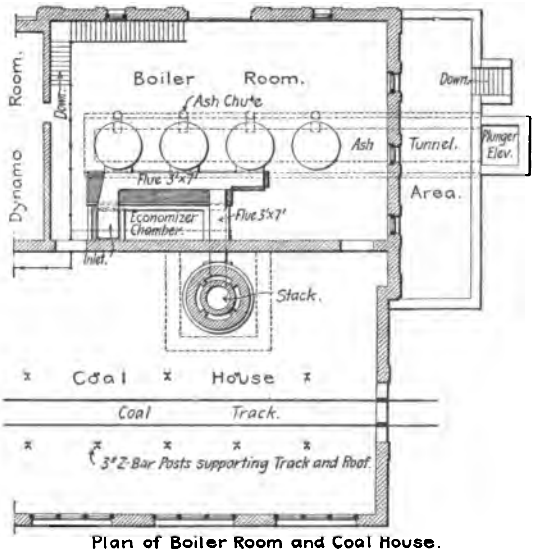
The boiler room contains three vertical fire-tube boilers, designed by Dean & Main and built by the Atlantic Works, under the specifications and inspection of the Distribution Department. They are 97⅞ inches inside diameter, 29.5 feet high over all, and contain 378 tubes, 2 inches external diameter, 15 feet long. The boiler flue is arranged to carry gases directly to the chimney, or to pass



THE ENGINEERING RECORD.

ICE PUMPING STATION.





Plan of Boiler Room and Coal House.

them through a 144-tube Green economizer. Directly under the boilers and extending outside the building there is a tunnel 6 feet wide and 7 feet 8 inches high, and through an opening in front of each boiler the ashes are dumped into a car which runs on a track in the tunnel. At the outer end of the tunnel there is a hydraulic lift which raises the car with its load to the yard level, and connects with a track extending to the dump. The coal house has a capacity of about 1,000 tons of coal, and is so arranged that the loaded cars are run into the building on a track about 15 feet above the floor.

In the engine room there is a 12-ton hand travelling crane, designed and erected by the New England Structural Company. The electric lighting plant consists of an 8-inch by 10-inch Fitchburg horizontal engine, and a 34½ kilowatt Westinghouse multipolar, direct current generator, directly connected to the engine. This plant is used for lighting both stations, and the old plant at the high-service station is kept in reserve.

The principal items of cost of this station, to December 31, exclusive of engineering, are as follows: —

Building, including foundations for engines and boilers, steel overflow tank, sluice valves, ash lift, heating piping and wiring for electric lighting,	$206,035 50
Engines,	117,648 85
Boilers and economizer,	23,632 55
Electric lighting engine, generator and switchboard,	2,087 00
Travelling crane,	2,747 00
Piping and valves in connection with engines and boilers,	15,755 25
Miscellaneous,	5,473 27
Total,	$373,379 42

GATE-CHAMBER AND PIPE CONNECTIONS AT CHESTNUT HILL RESERVOIR.

The construction of a gate-chamber on the shore of the reservoir, together with the work of laying pipes for the purpose of conveying water from the reservoir to both the low and high service pumping stations, was begun in August, 1899, and at the end of that year Baker & Judson, the contractors, had completed the greater portion of their work. The removal of the coffer-dam was begun January 17, and all of the sheet piling was removed on February 17. The contractor experienced considerable difficulty in removing the earth with which the coffer-dam was filled, and it was not until May 14 that this part of the work was finished. The laying of the 48-inch and 60-inch pipes was finished on March 10.

On April 21 a contract was made with John S. Jacobs & Son for building the superstructure, for the sum of $9,974, in accordance with plans furnished by Messrs. Wheelwright & Haven, architects. This building should have been finished on October 1, but, on account of delay in receiving cut stone, and from other causes, the work has been much delayed. On December 31 the window grilles and the bronze cheneau were not in place, although the building was otherwise practically finished.

The gate-chamber is 36 feet long by 21 feet wide. Water from the reservoir enters the chamber through three openings 6 feet in width, in which are cast-iron grooves for stop-planks and screens. The openings are covered by cast-iron floor plates. The cast-iron stop-plank grooves were furnished and the floor plates were furnished and set by the Coffin Valve Company of Boston. The flow of water from the reservoir into the pipes leading to the pumping stations is controlled by means of three 60-inch sluice gates operated by hydraulic power, which were furnished and set by the Atlantic Works of Boston.

The following shows the cost of the work to December 31, exclusive of the cost of the superstructure and of engineering: —

Gate-chamber,	$8,862 31
Sluice gates and wall pipes,	5,258 00
Floor plates and stop-plank grooves,	2,200 00
Pipes and laying, including valves, valve chambers, etc., 1,115 feet 60-inch and 635 feet 48-inch pipe,	28,537 49
Screens, stop-planks, temporary building, etc.,	2,048 22
Total,	$46,906 02

Spot Pond Pumping Station.

At the beginning of the year 1900 the exterior of the pumping station building was nearly finished. Between January 1 and June 1 the interior walls were cleaned down, the iron stairways put in place, the carpentry and plumbing work done, and the granolithic floors laid in the boiler and coal rooms and in the basement of the engine house. The building is now finished, with the exception of the slate tile floor, which is delayed on account of difficulty in obtaining slate.

The Leavitt engine was moved from the Mystic pumping station in 1899. It was started in its new location on February 15, and from March 22 to November 1 pumped all of the water used for the northern high-service district.

The first shipment of castings for the 20,000,000-gallon engine was received from the Holly Manufacturing Company on March 21, and the engine was started on November 1 and placed in regular service on November 20. The installation of the wiring for the lighting of the engines and of the pipes for heating the building has been done by the regular force employed at the station.

The pumping station building, built by McNeil Brothers, from designs by Messrs. Shepley, Rutan & Coolidge, has exterior walls of gray Roman brick, with buff Indiana limestone trimmings above a heavy base of pink Milford granite. The roof is covered with red Spanish tiles. The interior of the engine room is lined with red pressed brick, and the boiler and coal houses with common red brick. The pump-wells and the foundation walls of the building are all of cement concrete.

The building contains an engine room, 105 by 60 feet; a dynamo room, 49 by 16 feet; a boiler room, 53 by 49 feet; and a coal house, 71 feet 8 inches by 40 feet. At the rear of the engine room there are three pump-wells into which water can be supplied from Spot Pond or from the pipes coming from the low-service pumping station at Chestnut Hill. The flow of water into the pump-wells is controlled by four 36-inch sluice gates. The chimney is 125 feet in height, built of brick with limestone trimmings. The exterior is 11 feet square at the base and 9 feet square at the top. The flue is 4 feet in diameter.

The engine room contains at present two engines, one of 10,000,000 gallons daily capacity, designed by E. D. Leavitt for the city of Boston and erected by the Blake Manufacturing Company in 1895 at the Mystic pumping station, whence it was removed in 1899; and one of 20,000,000 gallons daily capacity, erected by the Holly Manufacturing Company of Lockport, N. Y. Space has been reserved in the room for a third engine for future use.

The boiler room contains three vertical fire tube boilers, designed by Dean & Main and built by the Lake Erie Boiler Works of Buffalo, N. Y. They are 92 inches in diameter, 29½ feet high, and contain 256 2¼-inch tubes, 15 feet long. The flue gases from the boiler can be taken directly to the chimney, or passed through a Green economizer containing 144 tubes.

The engine room contains a 12-ton hand travelling crane, designed and built by the New England Structural Company of Boston.

The principal items of cost of this station, to December 31, exclusive of engineering, are as follows: —

Building, including foundations for engines and boilers, sluice gates, heating piping and electric lighting,	$118,952 22
Engines,	68,889 87
Boilers and fuel economizer,	25,695 08
Travelling crane,	2,797 00
Water and steam pipes, valves, etc.,	9,790 13
Miscellaneous,	1,072 41
Total,	$227,196 71

FORBES HILL RESERVOIR AND STANDPIPE.

On July 7 a contract was made with Beckwith & Quackenbush of Herkimer and Mohawk, N. Y., for the construction of a reservoir and the foundation of a standpipe on the summit of Forbes Hill in Quincy. They began work on July 16, completed the concrete foundation for the standpipe on September 11, and at the end of the year the masonry gate chamber of the reservoir was finished, the pipes laid, the valves set, and the earth embankment of the reservoir was nearly ready for the concrete lining. The reservoir when completed will be rectangular in shape, 350 feet long by 170 feet wide, with a depth of 17 feet of water and a capacity of 5,000,000 gallons. In order to protect the embankments from frost, the reservoir has been filled with water to within 2 feet of the top of the embankments.

Adjoining the reservoir a steel standpipe, 30 feet in diameter and 64 feet 4 inches high, has been erected by Walsh's Holyoke Steam Boiler Works of Holyoke, Mass. The contract for this work was made July 20, the work of erection commenced October 15, and the standpipe placed in service on December 31. The standpipe is to be enclosed during the coming season by a masonry tower.

MISCELLANEOUS.

Early in the year an underground lead-covered cable, 5,140 feet in length, containing five conductors, was put in between the Fells Reservoir and the Spot Pond pumping station. Three of the conductors are used to operate a Winslow electric telemeter, which indicates and records at the pumping station the elevation of the water in the reservoir. Float gages showing the elevation of the water in the several pump-wells at the Chestnut Hill low-service and Spot Pond pumping stations, and in the new gate-houses at Spot Pond and Chestnut Hill Reservoir, have been constructed and set up.

Pressure-recording gages have been installed in Watertown, at the office of the Water Department; in Nahant, at the office of Mr. Wilson, chairman of the selectmen; and in Lynn, at the Central Fire Station on Broad Street.

At Chestnut Hill Reservoir a large amount of work has been done on the grounds in the vicinity of the pumping station, and new side tracks have been put in for delivering coal at the low-service station and pipes at the new pipe yard. The grounds about the station have been regraded and seeded, driveways built, the old wooden buildings moved, and a 6-inch sewer pipe 670 feet long laid between the two stations. In October granolithic walks were laid by Taylor, Carr & Andrews on the sidewalk in front of the pumping station lot and in the grounds approaching the buildings.

ENGINEERING.

The following are the principal items of work upon which the engineering force of the Distribution Department has been engaged during the year: —

Preparation of plans and contracts and the superintendence of construction of works for raising and improving Spot Pond, for reservoir and standpipe on Forbes Hill in Quincy, for laying 24-inch submerged pipes across Chelsea Creek between Chelsea and East Boston, and for tunnel under the Mystic River between Charlestown and Chelsea; superintendence of construction of buildings, engines, boilers and other machinery at the pumping stations at Chestnut Hill and Spot Pond.

Surveys and plans have been made for a reservoir and pipe line for supplying water to the town of Stoneham, and for a pipe line between the southern gate-house at Spot Pond and the present terminus of the 48-inch main near Tufts College.

Considerable time has been devoted to working up results of the test of the Allis engine at the Chestnut Hill high-service station, and the preparation of record plans of pipe lines, pumping stations and the Spot Pond improvement.

OFFICE FORCE.

ALFRED D. FLINN, *Principal Office Assistant*, JOHN N. FERGUSON, *Office Assistant.*

Mr. Flinn has continued at the head of the designing and drafting force. The number of men in the department at the beginning of the year was 10, which was the largest number employed at any time, and at the end of the year 9.

The most important matters upon which the force worked during the year were the Wachusett Dam, the Forbes Hill Reservoir and standpipe, the Weston Aqueduct and Reservoir, indexing and filing drawings, and plans of new offices for the Board in Boston.

Studies for the Wachusett Dam, which were in progress at the beginning of the year, were continued as the most important work of this force until the middle of the summer, when the plans were ready for letting the main contract for the construction of the dam. Studies for the various features of the dam were elaborated to such a degree as to require probably but little more study for the preparation of the final working drawings, except for the hydro-electric power plant which it is proposed to install in the down-stream gate-chamber.

To prepare for the letting of the dam, 22 sheets of drawings were made, reproduced by lithography and bound in a pamphlet of the same size as the specifications.

Studies for the Forbes Hill Reservoir, begun in previous years, were completed, and contract drawings were prepared not only for the reservoir but also for the standpipe connected therewith. Studies, contract drawings and specifications for a masonry tower to enclose the standpipe were well advanced toward completion at the end of the year. This work was done with the advice of Messrs. Shepley, Rutan & Coolidge as consulting architects.

Late in the year studies for the Weston Aqueduct and Reservoir were undertaken, and much work was done upon studies of sections of the aqueduct in tunnel and in cut and cover work; of the siphon and siphon chambers, where the valley of the Sudbury River is to be crossed; and of the head house and terminal chamber. Several land plans have been drawn relating to the aqueduct and reservoir, and the general features of the reservoir have received some attention.

The systematic filing and indexing of drawings were deferred when the offices of the Board were first established, and have been set aside several times since on account of the pressure of current work, until the task has become not only a large but a difficult and tedious one. However, a system has been developed and much progress has been made. For the various departments accession books have been provided, with the margins of the pages numbered for each drawing, and columns arranged to record the title, description, date, purpose, scale, kind of paper, size and filing number of each drawing. Each plan case has been given a number, and the drawers of each case numbered. Each drawing, when recorded in the proper accession book, receives an accession number, and when assigned a permanent filing place, a filing number, indicating the case and drawer where filed and its number in the drawer. The titles and other information relating to the drawings made to the present time have been written in the accession books. Two typewriters from the Library Bureau began on December 6 to write the card index from the accession books, and are still employed upon this work. The cards are now being arranged in a special cabinet, under suitable headings and subheadings for convenient reference, and it is hoped that the drawings may soon be properly filed and the card index made available for current use.

Preliminary studies for the adaptation of the houses numbered 1 and 3 Ashburton Place to the use of the Board for offices, the final plans for the location of the furniture therein and much miscellaneous work in connection with fitting the new offices, was done by this force.

Besides matters already mentioned, the following have engaged the attention of this force: —

Diversion of Water: Plans for the Nashua River Paper Company's suit for water damages.

Wachusett Reservoir: Land plans and plans for Legislative Investigating Committee and for hearings.

Sudbury Reservoir: Land plans.

Sudbury Dam: Regulating shutter for gate-house, stop-plank house and car.

Sudbury Aqueduct: Stairs at Echo Bridge, and land plans.

Marlborough Brook Filter-beds: Contract drawings for improvements.

Chestnut Hill Reservoir and Grounds: 10-ton stiff-leg derrick.

Chestnut Hill High-service Pumping Station: Boilers to replace Miles boilers Nos. 1 and 2, and steam piping for the same.

Low-service Pumping Station: Supports for 36-inch hydraulic-lift valves, railings around light wells, tile floor, and miscellaneous details.

Spot Pond Pumping Station: Changes in floor, fascia and railing for light wells, cast-iron floor plates, economizer engine and platform, and electric light fixtures.

Pipe Lines: Saugus River Bridge pipe box, and Chelsea Bridge fender guard.

Record Drawings: Clinton Sewerage; Wachusett Aqueduct, — culverts, highway bridges, Assabet Bridge, dams and open channel; Chestnut Hill High-service Pumping Station; Low-service Pumping Station, and Spot Pond Pumping Station.

Miscellaneous: Map for Legislative Committee on Metropolitan Affairs, drawings and tables for annual report, and diagrams of reservoir records.

In all, 143 finished drawings were made during the year, also many studies, sketches and computations.

Mr. Ferguson has continued in charge of the miscellaneous work of the office, such as procuring supplies, making blue-prints, filing plans and records received from outside offices, and has also made many investigations and computations.

Accidents.

Four fatal accidents have occurred during the year, all in connection with the railway used by Nawn & Brock in removing soil from the Wachusett Reservoir. The first accident occurred on June 13, when a laborer was struck by a construction train at Sawyer's Mills; on June 16 a second accident occurred at South Clinton, in which a car repairer jumped from the front end of a train moving in one direction upon the second track in front of a train moving in an opposite direction, and was struck by the front car of the last mentioned train; the shock threw the brakeman from this car, resulting in the death of both; the last accident occurred near the water tank at South Clinton, on September 2, when a water boy who was riding on the step of a locomotive was instantly killed in a collision between the locomotive and some cars standing on a side track.

MAINTENANCE.

In addition to the works maintained and operated in 1899, the maintenance and operation of the following works were begun in 1900: 27.37 miles of ditches in swamps upon the Wachusett and Sudbury watersheds; low-service pumping station at Chestnut Hill Reservoir, containing three 35,000,000-gallon engines; a pumping station at Spot Pond, containing one 10,000,000-gallon and one 20,000,000-gallon engine; a small temporary pumping station at Arlington; a gate-house and pipe connections with pumping stations at Chestnut Hill Reservoir; pipe yards at Chestnut Hill Reservoir and Glenwood; Spot Pond as a completed distributing reservoir; and a new line of pipe across Chelsea Creek from Chelsea to East Boston. In November the operations of the city of Boston in raising a highway across the marsh between Breed's Island and Revere made it necessary to temporarily discontinue the use of the pipe which supplies Breed's Island standpipe, and by arrangement with the city the water supply has since been pumped by the Board at the East Boston pumping station.

The pumping stations at Somerville, Chelsea, Malden, Medford, Everett and Saugus, which were maintained in 1899, and in some instances, during a part of 1900, at the expense of the Commonwealth, are no longer used, the operation of the last station being discontinued March 31, 1900.

There has been an unusual amount of heavy work in the maintenance department during the year, in replacing across Chelsea Creek a pipe formerly belonging to the city of Boston; in tunneling under the Mystic River, where the widening and deepening of a draw required the removal of an existing siphon; in replacing at the Chestnut Hill high-service pumping station two boilers which were not strong enough to carry steam at the pressure required for the larger pumping engines; and in lowering about 400 feet of a 48-inch high-service main to conform to a lowering of the grade of Boylston Street in Brookline.

Cities and Towns supplied in 1900.

The following cities and towns were supplied with water from the Metropolitan Works in 1900: —

Boston,
Chelsea,
Everett,
Malden,
Medford,
Melrose,
Quincy,
Somerville,
Arlington,
Belmont,
Nahant,
Revere,
Swampscott,
Watertown,
Winthrop.

Newton and Hyde Park, both of which are in the Metropolitan Water District, receive no water from the Metropolitan Works. An emergency supply was furnished to the town of Lexington for twenty days in September and October.

Organization of Maintenance Force.

At the beginning of 1900 there was a total maintenance force of 134, exclusive of such of the engineers in the department as devoted only a part of their time to maintenance, and exclusive of from 19 to 22 men employed by the cities and water companies in their own pumping stations, but paid for by the Commonwealth. At the end of the year the force employed directly by the Board had been increased by 17, making a total of 151, and the additional force employed during the previous year in the pumping stations of cities and water companies had been discontinued.

Rainfall and Yield.

The rainfall and yield for the first ten months of the year corresponded quite closely with those of the previous year. During the first three months there were very large rainfalls, with a correspondingly large flow in the streams, and during the subsequent months the rainfall was low and the flow of the streams was unusually small. The drought of 1899, however, continued until the 20th of January, 1900, while the drought of 1900 was ended by the heavy rain of November 24–27.

Taking the year as a whole, the rainfall was about 10 per cent. above the average. The exceptionally high rainfalls and yields were in February and March, when the rainfall upon the Sudbury watershed was 15.49 inches, while the average is 8.92 inches; and the yield of the watershed was 280,003,000 gallons per day, as against an average of 185,222,000 gallons per day. The exceptionally low rainfalls and yields were in July and August, when upon the Sudbury watershed the rainfall was 4.68 inches, while the average is 7.81 inches. The evaporation from the water surfaces during these months exceeded the yield from the watershed, so that in both months there was an excess of evaporation, amounting to an average of 1,948,000 gallons per day, while the average net yield during these months is 18,234,000 gallons per day.

During the five months from June to October, inclusive, the combined yield of the Wachusett and Sudbury watersheds was lower than in 1899; and, as stated in the report of last year, the yield of the Sudbury watershed during these five months in 1899 was less than any previous year included in the records.

Additional statistics relating to rainfall and yields of watersheds may be found in Appendix No. 4, tables 1 to 9.

STORAGE RESERVOIRS.

Charles E. Haberstroh, assistant superintendent at South Framingham, is in immediate charge of the storage reservoirs and other works on the Sudbury and Cochituate watersheds and of the Sudbury and Cochituate aqueducts, under the general direction of the Engineer of the Sudbury Department.

The drought of the previous year left, on January 1, 1900, but 6,428,400,000 gallons of stored water in the reservoirs connected with the Sudbury and Cochituate supplies, out of a total capacity of 15,858,500,000 gallons. The storage diminished to 5,970,900,000 gallons on January 14, after which it began to increase. The heavy rainfall in the latter part of January and in February and March brought the drought to an end and caused a rapid gain in storage, and before the end of April the reservoirs were full. Owing to the very dry weather during the summer, the increased consumption in the Metropolitan District and the water used in filling Spot Pond, the storage existing on the Sudbury and Cochituate watersheds reached a lower level than in 1899. The storage was reduced from

15,829,900,000 gallons on June 1 to 5,646,400,000 gallons on November 25. At this time the storage was 2,539,500,000 gallons less than on the same date in 1899; however, 1,280,000,000 gallons of this amount had been used in filling Spot Pond, and, deducting this amount, the storage was 1,259,500,000 gallons lower than in 1899.

The following table gives the quantity of water stored in the storage reservoirs at the beginning of each month. The second column gives the total in the reservoirs from which the supply is usually taken, the third column the storage in the other reservoirs, and the last column the total storage in all the reservoirs.

Quantity of Water stored at the Beginning of Each Month.

DATE.	In Sudbury Reservoir and Framingham Reservoir No. 3 (Gallons).	In All Other Storage Reservoirs (Gallons).	Total (Gallons).
January 1, 1900,	3,077,200,000	3,351,200,000	6,428,400,000
February 1,	3,081,800,000	4,348,900,000	7,430,700,000
March 1,	6,242,800,000	6,399,900,000	12,642,700,000
April 1,	8,031,100,000	7,018,300,000	15,049,400,000
May 1,	8,393,600,000	7,318,500,000	15,712,100,000
June 1,	8,407,100,000	7,422,800,000	15,829,900,000
July 1,	7,938,100,000	7,301,100,000	15,239,200,000
August 1,	6,751,100,000	6,373,200,000	13,124,300,000
September 1,	5,204,500,000	5,643,300,000	10,847,800,000
October 1,	3,800,200,000	4,503,100,000	8,303,300,000
November 1,	3,055,000,000	3,413,400,000	6,468,400,000
December 1,	3,744,000,000	3,188,800,000	6,932,800,000
January 1, 1901,	5,205,900,000	3,633,200,000	8,839,100,000

NOTE.—The storage in Dudley Pond is included in this table.

At the beginning of the year the water in the *Sudbury Reservoir* stood at elevation 245.06, which is 13.94 feet below the crest of the dam. The surface fell to 240.47 on January 20, 18.53 feet below the crest. The water then began to rise, and on March 31 reached the level of the crest. The flashboards having been put in place, the water rose to elevation 260.04 on April 5, and remained substantially at this level until June 10, when the draft upon the reservoir began to exceed the supply. The surface then lowered about 16.5 feet to elevation 243.45 on November 9; it then began to rise, and reached elevation 252.54 at the close of the year, 6.46 feet below the crest of the dam.

The Marlborough Brook filter-beds, at the head of one branch of the Sudbury Reservoir, have been in service during the year, and have filtered all of the water of the brook except for a few short periods during freshet flows. Experience gained in operating the beds has led to some changes and improvements in the system, which have been described under the head of construction.

Analyses have been made monthly by the State Board of Health of the water before and after passing through the filter-beds, and they show that the water is purified by filtration to a satisfactory extent. The average of all the examinations made during the year is as follows: —

[Parts per 100,000.]

	Before Filtration.	After Filtration.
Color (platinum standard),	0.45	0.06
Total residue on evaporation,	17.72	11.29
Loss on ignition,	4.50	-
Free ammonia,	0.1010	0.0096
Albuminoid ammonia,	0.0553	0.0071
Chlorine,	2.02	1.48
Nitrogen as nitrates,	0.1463	0.1828
Nitrogen as nitrites,	0.0046	0.0005
Oxygen consumed,	0.76	0.10
Hardness,	5.7	4.1

A considerable amount of work has been done during the year around the margins of the reservoir. In Southborough, near the cemetery, some low land has been drained and planted with evergreens.

Framingham Reservoir No. 3, which derives its supply almost wholly from the Sudbury Reservoir, was kept practically full throughout the year, with an extreme range of about 3 feet, depending upon the season. From April until the middle of June, during which time the flashboards were kept in position on the dam, the water was kept as high as possible, and during the remainder of the year it was kept slightly below the crest, to prevent a waste of water from the effect of the wind.

Framingham Reservoir No. 2. Water was drawn for use from this source at the rate of about 10,000,000 gallons per day for nineteen days in January and February, in order to avoid wasting water at a time when there was doubt if the Sudbury Reservoir would fill in the spring. Small quantities were also drawn from the reservoir from June 19 to July 28 and from August 9 to August 15. Between August 23 and December 5, when the water in the reservoir had improved by longer storage, a much larger quantity of water, ranging from 10,000,000 to 32,000,000 gallons daily, was used from this source, the level of the water being maintained by drawing from the Ashland, Hopkinton and Whitehall reservoirs. After December 5 all of the surplus water from this reservoir was allowed to run to waste.

Framingham Reservoir No. 1. Water in this reservoir was about 10 feet below the crest of the dam at the beginning of the year, on account of repairs to a 48-inch pipe. This work was completed January 4, and on January 27 the water reached the level of the crest of the dam. The reservoir has been kept practically full during the remainder of the year.

Ashland Reservoir. Water in this reservoir was about 29 feet below the spillway at the beginning of the year. On March 16 the reservoir was full, and remained so until July 19, when water was drawn to maintain the supply in Framingham Reservoir No. 2. On November 26 the surface was about 15 feet below the spillway; from that time the water rose until the end of the year, when it was about 10 feet below the spillway. The amount of water drawn from this reservoir was 969,900,000 gallons.

Hopkinton Reservoir. Water in this reservoir at the beginning of the year was about 24 feet below the spillway. On March 6 the reservoir was full, and remained so until July 17, when water was drawn to maintain the supply in Framingham Reservoir No. 2. On November 26 the surface had fallen to a level about 18 feet below the spillway; from that time the water rose until the end of the year, when it was about 12 feet below the spillway. In all, 957,700,000 gallons of water were drawn from this source, of which about 645,000,000 gallons were filtered through the filter-beds located just below the reservoir.

Whitehall Reservoir was drawn upon for about 15,000,000 gallons per day for the first four days of the year. It remained nearly full until August 26, when water was drawn in considerable quantities for the supply of Framingham Reservoir No. 2. On November 6, when the flow was stopped, the surface had fallen about 4 feet, and since that time the reservoir has been gradually filling. In October the flume in the temporary dam near the outlet was lowered about 5.5 feet, to permit draining the reservoir to a lower level. The amount of water supplied by this reservoir, from July to November, inclusive, was 649,700,000 gallons.

Farm Pond has been kept nearly full throughout the year. It lowered gradually during the summer, owing to the dry weather and the operations of the Framingham Water Company, and was refilled once at the request of that company.

On March 2, Jeremiah Mains, who had been foreman in charge of the maintenance of the reservoirs upon the Sudbury River watershed for many years, died, and his place was filled by the appointment of his son, William A. Mains, who was connected with the engineering force as leveller. Jeremiah Mains was one of the foremen on the construction of Chestnut Hill Reservoir, and had rendered faithful and continuous service as foreman on the Boston and Metropolitan Water Works from 1867 to the time of his death.

Lake Cochituate at the beginning of the year was about 4.5 feet below high water, but was full on February 25, and remained practically so until July 1, when the amount drawn by the aqueduct exceeded the supply, and the surface lowered gradually until November 25, when the water stood 9.05 feet below high water. It gained about a foot during the remainder of the year. Water was wasted at the outlet dam at times between February 16 and June 26. Water was drawn through the aqueduct to Chestnut Hill Reservoir from February 2 to March 28, from June 3 to June 8, and from June 28 to the end of the year, the quality of the water during these intervals having been sufficiently good to allow of its use. About 76,400,000 gallons were drawn from Dudley Pond into the lake from July 10 to July 26, during which time the level of the pond was lowered about 3 feet. At the beginning of the year Dudley Pond was about 3.5 feet below high water and on July 10 about 2 feet below high water. At the end of the year the water was 4.1 feet below high water.

The filter-beds, situated near the shores of Lake Cochituate and used for filtering the water of Pegan Brook, have been in use two hundred and thirty-two days throughout the year. In February and March the flow of the brook was quite large, but none of its water entered the lake unfiltered except during parts of three days in February and three days in March. During August, September and October the flow of the brook was comparatively small, and it was necessary to pump only on ten days in August and eleven days each in September and October. The total quantity of water pumped during the year was 223,916,400 gallons. The total amount of coal consumed was 208,560 pounds, making 1,074 gallons of water pumped per pound of coal.

When the water was drawn down during the autumn, a large amount of work was done around the margin of the Pegan Meadows, in the removal of objectionable vegetation, stumps and willow trees.

SOURCES FROM WHICH WATER HAS BEEN TAKEN.

During the year the only water supplied from local sources was 350,000 gallons pumped at Arlington in the first three days of the year, and 40,720,000 gallons drawn by the city of Medford from Wright's Pond, making in all an average of 113,000 gallons per day for the whole year from local sources. All of the supply except this very small quantity was furnished by the Metropolitan Works. The principal supply was taken from Framingham Reservoir No. 3, which derives its supply mainly from the Sudbury Reservoir, which is in turn supplied from the Nashua River. For short periods in January and February, and from June 19 to July 28 and from August 9 to December 5, with the exception of a few days, water was also drawn for the supply from Framingham Reservoir No. 2 in quantities ranging from 6,000,000 to 32,000,000 gallons daily, the latter being drawn between September 23 and December 3. Between February 2 and March 28, June 3 and June 8, and from June 28 to the end of the year, water was drawn almost constantly from Lake Cochituate.

AQUEDUCTS.

The *Wachusett Aqueduct* has been in continuous use throughout the year, except for four days immediately after the heavy freshet in the middle of February, when the pond above the temporary dam had been lowered below the bottom of the aqueduct by the removal of the stop-planks and gates in the large flume; and one day immediately after the freshet of March 2, when the water was quite turbid. During the time that the aqueduct was emptied in February it was cleaned inside for its whole length. The average daily flow for the whole year has been 60,452,000 gallons per day. From January 1 to February 4, from June 10 to November 26, and after December 14, substantially all the water in the river was turned through the aqueduct, except the amount permitted to flow down the river, in accordance with the provisions of the Metropolitan Water Act.

The usual work of maintenance of all the works connected with the aqueduct and of the ditches tributary to the open channel has been carried on throughout the year, and all of these works are in good condition.

The *Sudbury Aqueduct* was in continuous service except on a few occasions for a day at a time, when it was necessary to empty it for cleaning. The total flow averaged for the whole year was 85,867,000 gallons per day, which is 1,151,000 gallons more than the daily amount of water carried by the aqueduct last year.

The difficulty of finding opportunities for cleaning the interior of the aqueduct increases every year, as the consumption approaches the maximum capacity of the aqueduct. Between May 4 and June 7, cleaning took place from Framingham Dam No. 1 to Clark's waste weir. The brickwork was covered with a heavy coating of black slime; sponge in large quantities was present, principally on the invert, which was from one-half to three-fourths covered throughout the whole length of the aqueduct. An increase in the amount of sponge in the tunnels was observed, especially in the Badger Hill tunnel, where the rock was completely covered.

In the autumn, work was started on a retaining wall and steel stairway at Echo Bridge over the Charles River. The object of this improvement is to allow people to pass from the top of the bridge to Ellis Street under the bridge. The contractor for the stonework was the Webb Granite and Construction Company of Worcester, and for the steelwork is G. P. Bullard & Co. The stonework was completed by the middle of November, but the steelwork is still in course of erection.

Echo Bridge is 500 feet long, 18 feet wide, and the central arch has a span of 129 feet. As the summer was an unusually hot one, a few observations were made to determine the effect of expansion on the masonry. On July 3, when the temperature at 5 P.M. was

79° F., the amount of leakage flowing from under the iron door on Ellis Street was at the rate of 3 gallons per minute; on July 20, with a temperature of 63° F. at 5 P.M., the leakage was 1.5 gallons per minute; while on several days when the temperature reached from 93° to 101°, the leakage rose to about 8 gallons per minute. The expansion of the masonry causes longitudinal cracks, which close as the temperature falls.

The following repairs have been made upon the interior of the Waban arches: the cement work in the north gallery, which had been disintegrated by frost, was removed, and the floor for its entire length was repaired and plastered and a pitch given towards the middle gallery, so as to make the water flow more freely towards the tell-tale pipes. A portion of the south gallery flooring was treated in the same manner. Portions of the interior arches were also replastered. A steam heating plant has been installed at this bridge, to prevent the formation of ice in the galleries and other interior portions of the bridge. Steam was turned on December 11.

In Chestnut Street, Newton Upper Falls, a sewer was built by the city of Newton, crossing under the aqueduct in a culvert originally provided for the purpose. Three lengths of cast-iron pipe, 8 inches in diameter, with lead joints, were used in making the crossing. A 6-inch gas main, crossing over the top of the aqueduct, was also laid in the same street.

About 6,188 feet of new fencing have been built and 8,644 feet of old fences repaired, principally in Newton and Wellesley.

As the aqueduct is now run to nearly its full capacity much of the time, measurements are taken from time to time, to determine the height to which the surface of the water rises in different parts of the aqueduct with a known quantity flowing.

The *Cochituate Aqueduct* was in use two hundred and fifteen days. The total quantity of water conveyed by the aqueduct averaged for the whole year 12,236,000 gallons per day. The work of repairing in a systematic manner all of the cracks in the aqueduct where on embankments, which was in progress at the date of the last report, was continued until January 30, when the repairs were substantially completed, and it became necessary to discontinue them, in order to use the aqueduct. Practically all these cracks, from the westerly end down to and including those on Seaver's embankment easterly from the Waban station in Newton, have been repaired. The scraping of the interior of the four siphon pipes across the Charles River valley, which was in progress at the date of the last report, was completed in January. The aggregate length of pipe scraped was 4,671 feet. The number of cubic yards of iron rust removed was 37, and almost all of it came from the two 30-inch and the 36-inch pipes.

As a result of the scraping of the pipes, of lowering the level of the water in Chestnut Hill Reservoir and of running the aqueduct under a head at its upper end, 24,000,000 gallons daily were run through it for a short time during the month of July. This is a larger quantity than it had before been thought possible to run through this aqueduct.

Early in the year arrangements were made for taking current meter measurements of the flow in this aqueduct. A track board for guiding the meter was installed in Wellesley, at Station 283 + 63, and over it was erected a small shelter house. A number of observations were taken, and the flow through the aqueduct is now determined with greater accuracy than in the past.

The joints in the stone and brick masonry in the Dedman's and Wellesley waste weirs, also in the siphon chambers, were thoroughly repaired. The masonry connected with the manholes was also put in good condition. New stop-plank guides were placed in the Wellesley waste weir. Early in September the four siphon pipes were thoroughly reinforced with concrete at the proposed crossing of the road to be built by the Metropolitan Park Commission, who paid for the work.

The usual work of maintenance in connection with fences and culverts, patrol and repairs on the aqueduct, and mowing of weeds and bushes and loaming of embankments, has been carried on throughout the year.

The town of Wellesley has done a considerable amount of work on its highways and public buildings, which has been more or less connected with the maintenance of the Cochituate Aqueduct. Some of the aqueduct land has been taken for the widening of Central Street, near the corner of Linden Street, and 6 feet of clean gravel filled over the aqueduct. Land has also been taken by the town for the widening of Washington Street, but at the crossing of the aqueduct the additional filling over it was very slight. The town has been given a right of way across the aqueduct, to enable it to reach the department buildings at Wellesley Hills.

Pumping Stations.

Until June 1 the engines at the Chestnut Hill high-service station were used for pumping not only the water for the southern high-service district, but also for the portion of the Metropolitan Water District north of the Charles River. On that date the first of the engines at the new low-service station was placed in service, and these engines have since been used to pump most of the water for the low service. Since October 9, when all three engines at the low-service station became available for use, the water for the low-service district of Boston has been furnished by pumping instead of by gravity from the Chestnut Hill and Brookline reservoirs. This change was in accordance with the original recommendations of the State Board of Health, in its report upon a Metropolitan Water Supply in 1895. The increase in pressure was rendered necessary by the greater height of modern buildings, which, even upon the lowest lands, received an insufficient pressure by gravity. The pressure maintained since pumping was commenced has been equivalent to a head of from 20 to 25 feet in excess of that furnished by gravity.

Until March 7 the water for the northern high-service district was pumped at the local pumping stations in Malden, Somerville and Chelsea. On that date the Leavitt engine at the Spot Pond station was started, and on March 20 and 21 pumping was discontinued at the Malden and Somerville stations. On March 31 the pumps at the Chelsea station were stopped, and since that date all water for the northern high service has been pumped at the Spot Pond station. Water for the higher portions of the West Roxbury district has been pumped at the West Roxbury station, which has been leased from the city of Boston; and for the high-service district in Arlington at a temporary station, which was built in 1899 near the Brattle station of the Boston & Maine Railroad.

Until August 31 the operation of the stations was under the charge of Will J. Sando. Since that time J. W. Lynch, engineer in charge of the stations at Chestnut Hill, has been given general charge of the mechanical work at all of the stations, and the engineer of the Distribution Department retains the general supervision of their operation.

The present daily pumping capacity of all the stations is 204,000,000 gallons, and the force employed numbers 51.

The saving in the cost of pumping water in the Metropolitan Water District by discontinuing the use of many small stations is illustrated by the following figures, giving the cost of operating the seventeen stations in the District in the year 1897, before the introduction of the Metropolitan supply; of pumping in 1899, when several of the stations had been discontinued; and in 1900, when nearly all of the water was pumped at the three large stations of the Metropolitan Works: —

	Cost of Pumping.	Million Gallons Pumped.	Cost per Million Gallons.
1897, ...	$122,400 00	12,700.0	$9 64
1899, ...	84,633 90	19,846.5	4 26
1900, ...	90,931 28	27,207.2	3 34

Chestnut Hill High-service Station.

At this station the two 8,000,000-gallon auxiliary engines and the 20,000,000-gallon Leavitt engine have been used for both high-service and low-service duty. The 30,000,000-gallon Allis engine has been used only for high-service duty, and has pumped 90 per cent. of the water used to supply the southern high-service district.

The following are the statistics relating to operations at this station: —

	Low Service.		High Service.			Totals.
	Engines Nos. 1 and 2.	Engine No. 3.	Engines Nos. 1 and 2.	Engine No. 3.	Engine No. 4.	
Total quantity pumped (million gallons),	1,391.32	4,449.09	63.41	830.20	8,293.39	15,027.41
Total coal used (pounds), ...	1,118,215	2,305,955	156,827	737,941	5,627,514	9,946,452
Gallons pumped per pound of coal, . .	1,244.23	2,128.81	404.33	1,125.02	1,473.72	1,511
Average head pumped against (feet), .	48.70	52.08	125.08	128.26	125.34	96.44
Cost of pumping: —						
Labor, ...	$2,602 85	$5,066 88	$196 32	$1,127 27	$10,006 10	$18,998 92
Fuel, ...	1,989 82	4,105 56	278 96	1,313 51	10,018 22	17,706 07
Repairs, ...	2,011 68	1,701 63	282 14	543 26	2,299 08	6,837 79
Oil, waste and packing, ...	36 86	258 92	3 69	66 34	555 61	921 42
Small supplies, ...	120 97	250 59	17 28	79 93	611 35	1,080 12
Total for station, ...	$6,762 18	$11,383 08	$778 39	$3,130 31	$23,490 36	$45,544 32
Cost per million gallons pumped to reservoir,	$4 860	$2 558	$12 276	$3 771	$2 832	$3 031
Cost per million gallons raised one foot high,	100	049	098	031	023	031

Coal has been furnished for use at the station as follows: —

Loyal Hanna Coal and Coke Company, .	2,525.35 gross tons, at $3.67 per ton.
E. B. Townsend, ...	688.90 gross tons, at $4.09 per ton.
Loyal Hanna Coal and Coke Company, .	1,209.14 gross tons, at $4.78 per ton.
Gillespie & Pierce (screenings), . .	100.00 net tons, at $2.00 per ton.
Gillespie & Pierce, ...	45.18 net tons, at $4.50 per ton.

In order to provide additional boiler capacity for operating engines Nos. 3 and 4, the two horizontal return tubular boilers which were installed with the Gaskill engines in 1885 are being replaced by two boilers of similar type, designed to carry 185 pounds steam pressure. A contract for building and delivering these boilers at the station was made on September 26, with the Lake Erie Boiler Works, for the sum of $2,450 each. The boilers arrived at the station about the middle of December, and are now being placed in position. They are of the return tubular type, each 64 inches in diameter, containing 102 3-inch tubes, 18 feet long. Mechanical stokers, furnished by the American Stoker Company of New York at a cost of $1,000, are to be used in connection with the boilers.

The cost per million gallons of water raised one foot high at this station was $0.031, which is slightly less than the cost in 1899. As the cost of repairs in 1900 was large, on account of the purchase of the new boilers and stokers, and as the cost of coal was $0.45 per ton more than during the previous year, the cost per million gallons pumped is very satisfactory.

Chestnut Hill Low-service Pumping Station.

At this station three 35,000,000-gallon engines, built by the Holly Manufacturing Company, have been placed in service. Engine No. 5 was started on June 1, engine No. 6 on July 3 and engine No. 7 on September 27. The engines were put into regular service before their final completion, and at the present time some work remains to be done on all of the engines. They have operated very satisfactorily, and the duty is constantly improving.

The following are the statistics relating to operations at this station: —

	Engines Nos. 5, 6 and 7.
Total quantity pumped (million gallons),	9,431.14
Total coal used (pounds),	3,779,657
Gallons pumped per pound of coal,	2,495.24
Average head pumped against (feet),	51.82
Cost of pumping: —	
Labor,	$7,499 38
Fuel,	7,469 24
Repairs,	62 09
Oil, waste and packing,	487 23
Small supplies,	361 52
Total for station,	$15,879 46
Cost per million gallons pumped to reservoir,	1 684
Cost per million gallons raised one foot high,	032

Coal for use at the station has been purchased as follows: —

Loyal Hanna Coal and Coke Company,	386.81 gross tons, at $3.67 per ton.
E. B. Townsend,	379.16 gross tons, at $4.09 per ton.
Loyal Hanna Coal and Coke Company,	1,704.01 gross tons, at $4.78 per ton.

Pumping for the Northern High-service District.

In 1898 the water for the northern high-service district was pumped at ten local pumping stations, because the Metropolitan Water Works were not far enough advanced to enable the pumping to be concentrated. At the beginning of 1899 arrangements were made with the water departments having the larger pumping stations, for the operation of the stations by the Metropolitan Water Board, concentrating the pumping during the greater part of the year in four stations, but for a small portion of the year it was necessary to utilize two others. This produced a considerable saving, and the cost of pumping 2,337,290,000 gallons was $32,860.33.

In the early part of 1900 three of these pumping stations were operated until an engine in the Spot Pond station was in readiness for use, after which the pumping was done at this station, with a further saving in cost.

As only one engine was available at the Spot Pond station until November 1, several of the local stations were kept in readiness for use in case of emergency.

The cost of operating the Spot Pond station, where 80.4 per cent. of the water for this district was pumped, was $10,858.98; of operating the other stations, where the remainder of the water was pumped, and of maintaining the stations subsequently in readiness for use, was $10,564.75, making a total of $21,423.73, which is a saving over the cost for the previous year of $11,436.60. The results obtained at the Spot Pond station show that there will be a still further saving in cost next year.

The local stations used in 1900 in connection with the Metropolitan Works included the Somerville, Malden, Chelsea and Medford stations. No water was pumped at the Medford station, but it was kept in readiness for use until April 21. Pumping was discontinued at the Somerville station on March 19, at the Malden station on March 20 and at the Chelsea station on March 31. The total number of gallons pumped at these stations was 492,900,000. One engineer was retained at both the Somerville and Chelsea stations, to keep the machinery in readiness for use, until about the middle of October.

Spot Pond Pumping Station.

The operation of one pumping engine at this station was begun on March 7, and after March 31 all the water used by the northern high-service district was pumped here. Until November 1 the water was pumped by the 10,000,000-gallon Leavitt engine, known as No. 8. On that date the new 20,000,000-gallon engine, built by the Holly Manufacturing Company, known as No. 9, was started, and since November 20 this engine has been used exclusively.

The following are the statistics relating to operations at this station: —

	Engines.		Both Engines.
	Number 8.	Number 9.	
Total quantity pumped (million gallons),	1,728.10	287.03	2,015.13
Total coal used (pounds),	2,295,878	325,681	2,621,559
Gallons pumped per pound of coal,	752.70	881.32	768.68
Average head pumped against (feet),	126.52	122.50	125.95
Cost of pumping: —			
Labor,	$3,626 65	$727 07	$4,353 72
Fuel,	4,946 98	701 84	5,648 82
Repairs,	43 97	-	43 97
Oil, waste and packing,	274 17	74 20	348 37
Small supplies,	386 60	77 50	464 10
Total for station,	$9,278 37	$1,580 61	$10,858 98
Cost per million gallons pumped to reservoir,	$5 369	$5 507	$5 389
Cost per million gallons raised one foot high,	042	045	043

Coal has been purchased for use at this station as follows: 1,241.42 gross tons Cumberland coal, at an average price of $4.77 per ton; 427.74 gross tons of anthracite coal, at an average price of $5.07 per ton; 127.81 gross tons anthracite screenings, at an average price of $3.07 per ton.

West Roxbury Pumping Station.

The following are statistics relating to operations at this station for the year 1900: —

Daily average quantity of water pumped (gallons),	355,000
Daily average quantity of coal consumed (pounds),	2,000
Gallons pumped per pound of coal,	177
Cost of pumping: —	
Labor,	$2,633 30
Fuel,	1,895 71
Repairs and small supplies,	188 05
Total for station,	$4,717 06
Cost per million gallons pumped to reservoir,	36 41
Cost per million gallons raised one foot high,	279

The daily average quantity pumped was 16.8 per cent. over the amount pumped in the previous year.

Arlington Pumping Station.

The pumps at this station were first started on January 1, and since January 3 they have pumped all the water for the high-service district of the town of Arlington. From September 14 to October 3, inclusive, a portion of the supply of the town of Lexington was pumped at this station. The total quantity supplied to that town was 2,519,000 gallons. The plant is a temporary one, consisting of two small pumps purchased from the town of Arlington, located in a small wooden building near the Brattle station of the Boston & Maine Railroad.

The following are the statistics relating to operations at this station: —

Daily average quantity of water pumped (gallons),	304,000
Daily average quantity of coal consumed (pounds),	1,924
Gallons pumped per pound of coal,	158
Cost of pumping: —	
Labor,	$2,003 67
Fuel,	945 50
Repairs and small supplies,	417 54
Total for station,	$3,366 71
Cost per million gallons pumped to standpipe,	30 31
Cost per million gallons raised one foot high,	112

East Boston Pumping Station.

On account of the raising of the grade of Bennington Street between Revere and Breed's Island, it was found necessary in November to discontinue through the winter the use of the 12-inch pipe through which the supply to the standpipe on Breed's Island was furnished. Permission was obtained from the Water Commissioner of Boston to use one of the pumps in the old East Boston pumping station, belonging to the city of Boston; and since November 7 the supply for the small district on Breed's Island has been pumped at this station. One man is employed to operate the pump, and about 50,000 gallons per day are pumped to the standpipe.

Detailed statistics with regard to the operation of the several stations may be found in Appendix No. 4, tables 13 to 19.

CONSUMPTION OF WATER.

The daily average quantity of water consumed in the cities and towns in the Metropolitan Water District, supplied wholly or in part by the Metropolitan Water Works during the year 1900,* was 94,205,000 gallons, equivalent to 115.5 gallons per inhabitant in the District supplied. Of the above quantity, 94,092,000 gallons per day were supplied by the Metropolitan Water Works, and 113,000 gallons per day from local sources. The increase in the daily average consumption of water in these cities and towns over that of the previous year was 5,672,000 gallons, or 6.4 per cent. On account of the mild winter, the consumption during the first six months of the year was but little more than for the corresponding months in 1899, but during the last six months there was a large increase in the consumption.

The daily average consumption of water in the low-service district was 62,659,000 gallons, — an increase of 3.7 per cent. over that in the same district in 1899.

In the southern high-service district the consumption was 24,021,000 gallons, — an increase of 16.4 per cent. over the preceding year. The relatively greater increase in the consumption in the high-service as compared with the low-service district is accounted for, at least in part, by the extension of the high service which changed the lines separating the districts. In the northern high-service district the consumption was 6,865,000 gallons, which is apparently a slight decrease as compared with the figures of the preceding year. It now seems probable that the figures for the consumption of water in this district in 1899 were too large. The water was then pumped at nine small stations, and the quantity determined by pump measurements. It is probable that sufficient allowance was not made for the slip or leakage of water through the pumps.

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* Excluding Newton and Hyde Park, which are in the Metropolitan Water District, but receive no water from the Metropolitan Works.

The daily average consumption of water in the southern extra high-service district in West Roxbury was 355,000 gallons, and in the northern extra high-service in Arlington 305,000 gallons.

Detailed statistics of the consumption of water may be found in Appendix No. 4, tables 20 to 25.

QUALITY OF WATER.

Samples of water were collected every two months from ten points, monthly from six points and weekly from three points upon the works, and sent to the State Board of Health for analysis and examination. Samples of water have also been collected each week from many points upon the works and examined microscopically and for color, odor and taste, and during a portion of the year for turbidity, by the biological force of the Metropolitan Water Board.

The quality of the water furnished has not been quite as good as in the previous year, and for this there are several reasons. The best water supplied to the District is that taken from the Sudbury Reservoir and Framingham Reservoir No. 3, which derive their supply mainly from the Nashua River. Owing to the increase in the quantity of water consumed and the quantity of water required for filling Spot Pond, together with the unusually dry season, a smaller proportion of the water was taken from this source, and more had to be taken from the southerly branch of the Sudbury River, on which Framingham Reservoir No. 2 is situated, and from Lake Cochituate. The proportion taken from these less satisfactory sources was 14.2 per cent. in 1899 and 22.6 per cent. in 1900.

The fact that the reservoirs were very low at the beginning of the year, so that they did not carry over as much water that had been improved by long storage, was another important factor in the quality of the water in 1900.

The following table gives a comparison of the average results of examinations made for the years 1897, 1898, 1899 and 1900: —

Comparison of Examinations of Boston Tap Water, 1897, 1898, 1899 and 1900.

	1897.	1898.	1899.	1900.
State Board of Health Examinations.				
Color (Nessler standard),	0.65	0.41	0.23	0.24
Total residue,	4.82	4.19	3.70	3.80
Loss on ignition,	1.84	1.60	1.30	1.20
Free ammonia,	0.0009	0.0008	0.0006	0.0012
Albuminoid ammonia, total,	0.0193	0.0152	0.0136	0.0157
Albuminoid ammonia, dissolved,	0.0177	0.0136	0.0122	0.0138
Albuminoid ammonia, suspended,	0.0016	0.0016	0.0014	0.0019
Chlorine,	0.40	0.29	0.24	0.25
Nitrogen as nitrates,	0.0137	0.0097	0.0137	0.0076
Nitrogen as nitrites,	0.0001	0.0001	0.0001	0.0001
Oxygen consumed,	0.64	0.44	0.35	0.38
Hardness,	1.6	1.4	1.1	1.3
Metropolitan Water Board Examinations.				
Color (platinum standard),	0.59	0.40	0.32	0.34
Total organisms,	351	230	192	468
Amorphous matter,	177	131	201	97
Bacteria,	105	96	117	181

Note. — Chemical analyses are in parts per 100,000, organisms and amorphous matter in standard units per cubic centimeter, and bacteria in number per cubic centimeter. The standard unit has an area of 400 square microns, and by its use the number of diatomaceæ are decreased, and the number of chlorophyceæ and cyanophyceæ are very much increased, as compared with the number of organisms.

The examinations for 1897 cover a period when no water was taken from the Nashua River; in 1898 the Nashua River water was used only during the last eight months, and in 1899 and 1900 it was in use for the whole year. As stated in a previous report, there was a very great improvement in the quality of the water from 1897 to 1899. The chemical analysis indicates only a very slight change for the worse from 1899 to 1900. The microscopical examinations show that there were, as a rule, many more of the organisms which may affect the odor and taste of water in 1900 than in the previous year.

The rapid increase in the consumption of water will make it difficult, in the next two or three years, before the Wachusett Reservoir and the Weston Aqueduct are in operation, to maintain the standard of quality of 1899 and 1900, since it will be necessary to operate both the Sudbury and Cochituate aqueducts in order to convey the required quantity of water, and it may be necessary to take a larger proportion of the water from the less satisfactory sources.

During the greater part of the year no water was drawn from Spot Pond for use in the District, and during much of the year the water was unfit for use. In March it was found that the water was of good quality, and from March 19 to 26 water was drawn from the pond for supplying a portion of the District and to lower the pond. In July the improvement of the pond as a distributing reservoir was so far completed that it was connected with the system, and the work of refilling it was commenced. Water was kept constantly running into the pond until the latter part of the year, when it had improved in quality so much that it was satisfactory for use.

Appendix No. 4, tables 26 to 35, gives the detailed results of chemical, microscopical and bacterial examinations of water from various parts of the Metropolitan Water Works.

Biological Laboratory.

On July 31, 1900, Dr. Frederick S. Hollis, chief biologist, resigned, to accept a position at Yale University, and was succeeded by his first assistant, Horatio N. Parker.

During the year 2,640 microscopical and 1,245 bacterial examinations of water were made at the laboratory of the Metropolitan Water Board, at No. 3 Mt. Vernon Street, Boston. Of the microscopical examinations, 2,070 were of the regular weekly samples and 570 were made in connection with special examinations.

The principal results of the work done by the biological force are given in Appendix No. 4. Table No. 33 gives the results of the microscopical examinations, Table No. 34 of the bacterial examinations, Table No. 35 gives the colors of the water and Tables Nos. 36 and 37 the temperatures of the water and air.

Sanitary Inspection.

The sanitary inspection on the watersheds at the sources of supply, described in the last report, has been continued under the direction of William W. Locke, C.E., sanitary inspector. The greater part of the inspection has been upon the Sudbury and Cochituate watersheds, where there is a large population, but he also devotes a portion of his time to the inspection of the Wachusett watershed. The results obtained continue to be very satisfactory.

A summary of the work done in 1900 upon the Sudbury and Cochituate watersheds is given in the accompanying tables. The first table shows the number of premises inspected, a classification of the cases inspected and the condition of the premises at the end of the year. The headings of this table explain themselves, except in a few instances; under the heading "Suspected" are included all cases where positive information could not be obtained, and where it is suspected that there may be some objectionable drainage; under the heading "Premises Vacant" are included all cases which at present furnish no objectionable drainage, but which might furnish such drainage if the premises were occupied; under the heading "Unsatisfactory" are included all cases where there may be, under the most unfavorable conditions, wash from privies or direct sink drainage, all suspected cases and all cases of manufacturing wastes entering feeders, even though there may be some attempt at previous purification.

The second table shows the improvements effected in 1900. No cases are entered as remedied unless complete sewer connections have been made or all probability of future contamination has been removed, and no cases are entered as partly remedied except where positive improvement in the sanitary condition has been effected.

Summary of Sanitary Inspections on the Sudbury and Cochituate Watersheds in 1900.

DISTRICT.	Number of Premises inspected.*	Classification of Cases inspected.									Condition at End of Year.	
		Cesspools dug before 1900.	Cesspools dug in 1900.	Direct Privy Drainage.	Indirect Privy Drainage.	Direct Sink Drainage.	Indirect Sink Drainage.	Manure Piles.	Manufacturing Wastes.	Premises Vacant.	Satisfactory.	Unsatisfactory.
Sudbury Watershed.												
Farm Pond,	3	1	-	-	-	-	1	1	-	-	3	-
Framingham Reservoir No. 3,	7	6	-	-	-	-	1	2	-	-	7	-
Stony Brook,	52	26	5	-	-	2	5	6	1	7	47	5
Angle Brook,	434	209	19	-	3	11	76	29	1	39	383	51
Framingham reservoirs Nos. 1 and 2 and Cold Spring Brook,	27	16	3	-	-	-	8	2	-	1	25	2
Eastern Sudbury,	36	18	1	-	-	-	12	2	-	10	33	3
Indian Brook,	48	18	1	-	-	-	26	4	-	3	38	10
Western Sudbury,	24	10	-	-	-	-	8	3	1	3	19	5
Whitehall Reservoir,	5	4	-	-	1	-	2	1	-	-	3	2
Cedar Swamp,	53	29	1	-	-	1	8	-	1	2	49	4
Cochituate Watershed.												
Snake Brook,	38	15	3	-	-	-	14	3	1	1	33	5
Pegan Brook,	193	85	1	-	2	-	16	12	2	5	176	17
Course Brook,	6	4	-	-	-	-	1	-	-	1	6	-
Beaver Dam Brook,	115	61	4	-	-	3	18	11	4	3	105	10
Totals,	1,041	502	38	-	6	17	196	76	11	75	927	114

* Not including a large number of premises which were found on examination to be in a satisfactory sanitary condition, and likely to remain so. On some premises there are two or more cases.

Sanitary Improvements effected on the Sudbury and Cochituate Watersheds in 1900.

DISTRICT.	Remedied by Sewer Connections.	Otherwise remedied.	Partly remedied.	Cesspools abandoned on Account of Sewer Connections.
Sudbury Watershed.				
Farm Pond, ...	-	-	-	-
Framingham Reservoir No. 3, ...	-	-	-	-
Stony Brook, ...	-	-	5	-
Angle Brook, ...	58	3	19	50
Framingham reservoirs Nos. 1 and 2 and Cold Spring Brook, ...	-	-	3	-
Eastern Sudbury, ...	-	-	1	-
Indian Brook, ...	-	-	1	-
Western Sudbury, ...	-	-	-	-
Whitehall Reservoir, ...	-	-	-	-
Cedar Swamp, ...	12	-	1	12
Cochituate Watershed.				
Snake Brook, ...	-	-	3	-
Pegan Brook, ...	75	-	1	75
Course Brook, ...	-	-	-	-
Beaver Dam Brook, ...	14	2	4	14
Totals, ...	159	5	38	151

A steady improvement in the sanitary conditions prevailing on the watersheds has been made during the year, particularly in districts where there are street sewers. This is true in a marked degree in Pegan and Angle brook districts, which include the greater part of the town of Natick and the city of Marlborough.

In Natick 75 cesspools have been abandoned on account of sewer connections, as compared with 74 last year and 36 in 1898. In many of these cases the cesspools were a menace to the purity of the water supply on account of being near the brooks, or because the owners were inattentive and allowed the cesspools to overflow.

In Marlborough a marked improvement has been made in the sanitary conditions. A complete improvement by sewer connection has been made in 58 cases and in other ways in 3 cases, while 19 cases have been partly remedied. The corresponding figures for last year are 14, 1 and 3. The improvement this year is partly due to the very efficient assistance rendered the inspectors of the Metropolitan Water Board by the Marlborough board of health.

In South Framingham a new low-level sewer has been begun by the town, designed to take the sewage from the section adjacent to Beaver Dam Brook. In this district there are at present 79 houses and 4 factories which have no proper method of sewage disposal. Some further work must be done on the sewer before it can become available for carrying off the sewage of this district.

Distributing Reservoirs.

The distributing reservoirs maintained by the Metropolitan Water Board are the Chestnut Hill Reservoir, Waban Hill Reservoir, Spot Pond, the Mystic distributing reservoir near Tufts College, the Fells Reservoir of the northern high service in the Middlesex Fells Reservation, and the Arlington standpipe. The Forbes Hill standpipe in Quincy was placed in service on the last day of the year.

Chestnut Hill Reservoir.

During portions of the year the Bradlee basin, and some of the time the Lawrence basin, have been kept below high-water level, for the purpose of increasing the discharge of the Cochituate Aqueduct and to facilitate the work of building the gate-house for supplying water to the pumping stations.

On October 9, when the change was made by which water was supplied to the low-service district of Boston by pumping instead of by gravity, the gates connecting the reservoir directly with the mains leading to the city were closed. The usual work has been done around the reservoir, and it is in good condition.

Richardson W. Sawtell, foreman at Chestnut Hill Reservoir, who has been connected with the works ever since the construction of the reservoir, was, through illness, obliged to give up work on December 29. Frederick W. Clark, who has also been connected with the works for many years as clerk at the reservoir and pumping station, with a general supervision of the work at the reservoir, has been relieved of his work in connection with the pumping station, and has been given the duties of Mr. Sawtell as foreman.

Waban Hill Reservoir.

This reservoir was purchased from the city of Newton on October 12, 1900. It was built in 1877, and has a capacity of 13,500,000 gallons. In 1891 the city of Newton constructed a covered reservoir at a higher level, and since that time this reservoir has been but little used. The water stored in the reservoir at the time of the purchase was of poor quality, and on November 22 the work of drawing the water off and wasting it was commenced. It was found necessary to pump the water from the bottom of the reservoir, and it was not until December 9 that it was entirely empty. The sediment on the slopes and bottom of the reservoir was removed and the surfaces were thoroughly cleaned. Two hundred and eight double loads of frozen material were removed. This material contained a very large percentage of water, so that the number of loads does not fairly represent the actual amount of sediment removed from the reservoir. Some of the joints between the paving stones were chinked, and the exterior woodwork of the gate-house was painted. Water was admitted to the reservoir on December 12, and the reservoir was full on December 17.

Spot Pond.

On January 1, 1900, the elevation of the surface of the water in the pond was 144.2 feet above Boston city base, or 9.8 feet below the old high-water mark. The heavy rainfall during January and February caused the pond to rise about 3.5 feet. From March 19 to 26, inclusive, water was drawn from the pond for the supply of the District, and the surface lowered to elevation 144. From the latter date until July 12 the pond was shut off from the distribution system, and the yield of the pond was wasted into Spot Pond Brook. On July 12 the improvement of the pond was so far completed that the work of refilling the pond by pumping from Chestnut Hill was commenced. The pond level was raised about 1 foot, where it remained until August 15, when pumping into the pond was resumed. On September 1 the surface was at elevation 145.14; October 1, 149.49; November 1, 153.94; December 1, 158.08; and December 31, 159.54, or 3.46 feet below the new high-water mark. On the last date the pond contained 1,450,000,000 gallons, while the capacity of the full pond is 1,791,700,000 gallons.

Mystic Reservoir.

Considerable work has been done on the roadways, and the joints in the granite walls surrounding the reservoir have been repointed above high-water mark with Portland cement. The reservoir, gatehouse and grounds are now in good condition.

Fells Reservoir.

This reservoir has been in constant use, and has remained very nearly full during the entire year. One man has been employed, to remove leaves from the water, clean screens and keep the grounds in repair. Some of the newly filled areas around the reservoir were seeded in the spring, the dead trees in the vicinity were cut out, and a portion of the driveway resurfaced.

Arlington Standpipe.

The exterior of the Arlington standpipe has been cleaned and painted, at a cost of $130.

MYSTIC LAKE AND PUMPING STATION.

These works are not used for water supply purposes at the present time. One man has been employed at Mystic Lake, to care for the buildings and other property. The bridge at the dam has been replanked. Two of the wooden buildings formerly used as temporary pumping stations have been leased to the Medford Boat Club, and have been remodelled for its use. At the Mystic pumping station the dwelling house, stable, store house, coal shed and other wooden buildings have been repainted.

PIPE LINES.

At the close of the year there were 69.82 miles of pipe lines controlled by the Metropolitan Water Board. These are maintained by forces at the pipe yards at Chestnut Hill and Glenwood, under the direction of George E. Wilde, assistant superintendent.

During the year 2 breaks and 38 leaks have been repaired in the Metropolitan mains. The break causing the greatest damage occurred on March 30, when the 20-inch high-service main in High Street, near Broadway in Everett, was broken by water hammer caused by the action of an automatic valve regulating the flow into the Revere reservoir. The streets in the vicinity of the break were badly washed, and the cost of repairing the same was about $900. The other break occurred on October 1, when the 48-inch main on Boylston street in Brookline was broken by blasting for a gas pipe trench. Although a large volume of water escaped, the damage to the street was not large, as it was in an unfinished condition. The cost of repairing this break was paid for by the contractor who was excavating the gas pipe trench.

The leaks which have been repaired have, with one exception, been at lead joints, and 14 of them have occurred at the river crossings, 8 on the pipes crossing the Mystic River between Somerville and Medford and 6 on one of the 24-inch lines crossing Chelsea Creek. Two of the leaks at the Mystic River were at joints at the bottom of the channel, requiring the service of a steam dredge and diver in making the repairs; and, in order to prevent future trouble, these joints were securely bolted together with bolts two inches in diameter, fastened to clamps which were bolted around the pipes. The cost of repairing these two leaks was $1,074.67.

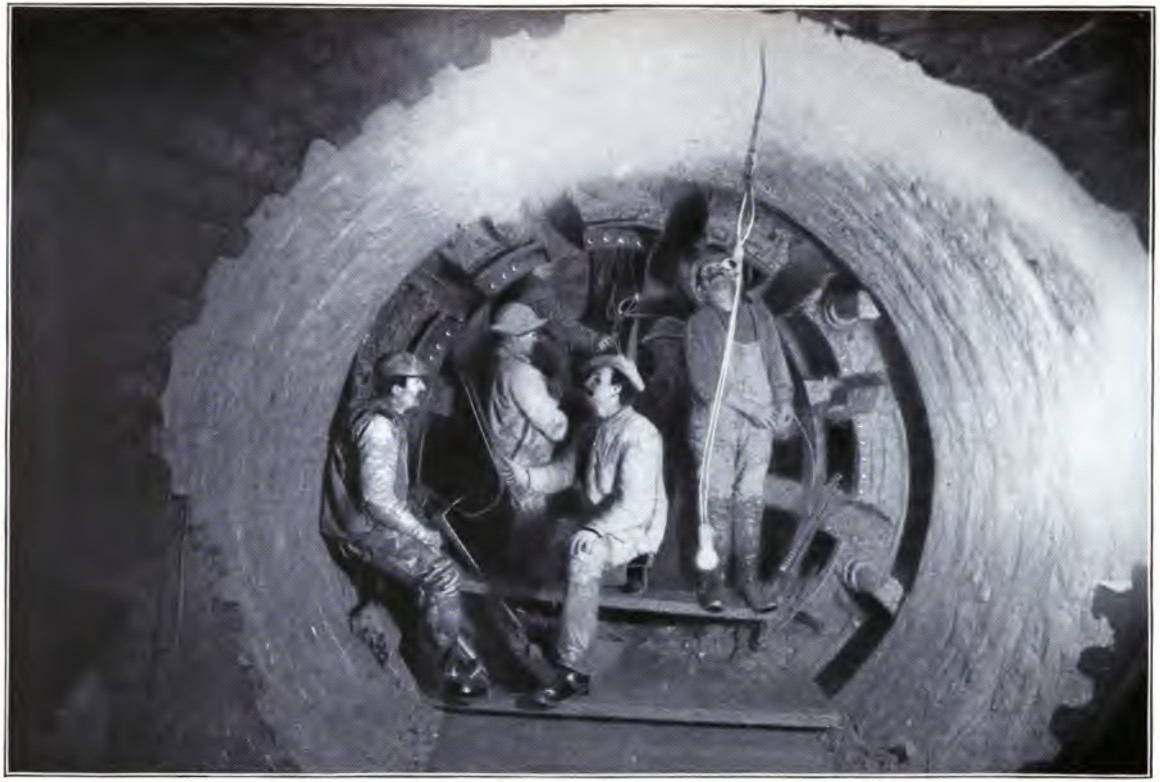
On May 10 a taking was made of the 20-inch and 24-inch pipes belonging to the city of Boston from the Boston side of the draw at the Mystic River, through the city of Chelsea and crossing Chelsea Creek to East Boston, a distance of about 5,300 feet. At the crossing of Chelsea Creek the 20-inch pipes which were laid in 1850 were badly tuberculated and very weak, on account of the action of salt water and mud upon the iron. These pipes for a distance of 1,438 feet have been replaced during the past season by a new line of 24-inch pipes. The channel at the point of crossing is about 600 feet wide at low water, with a maximum depth of 23 feet, and 1,425 feet wide at high water. When originally laid, pipes with ordinary bell and spigot joints were used above low-water mark, supported on a pile foundation, and pipes with flexible joints were used below low-water mark. The new line has been laid in the same manner, utilizing the old pile foundation for supporting the new pipes.

A contract for taking up the old pipes, making the necessary changes in the pile foundations, laying the new pipes and rebuilding the pile fender guard which protects the pipes above low-water mark from passing vessels was made with MacRitchie & Nichol of Chicago, on July 31. They began work early in August, completed the pipe laying on October 13, and the entire work on December 15. Crossing the channel for a distance of 631 feet the new pipes are 1¼ inches in thickness, and have ball and socket joints which permit of a deflection of 1 in 6 in any direction.

These pipes were laid in a cradle which was suspended alongside a large scow from derricks fitted with powerful hoisting gear. The cradle was long enough to receive six 12-foot lengths of pipe, and was curved to a radius slightly greater than the minimum radius to which the pipes could be deflected. As the pipes were joined together, the scow and cradle were drawn ahead and the pipes lowered into the channel which had been dredged to receive them. The work of laying the submerged pipes occupied thirteen days. After completion the entire line, 1,438 feet in length, was subjected for an hour to a water pressure of 84 pounds per square inch, and during that time no leakage was detected by a ¾-inch meter. The fender guards built to protect the pipes have a total length of 597 feet. They are constructed with oak piles and spurshores, spaced about 16 feet apart, with double girder caps of 7-inch by 14-inch hard pine timber, and a rider cap of hard pine, 8 inches by 16 inches. The amount of the contract was $14,437.52. The cost of all this work, including the cost of the pipes, but exclusive of engineering, was $19,500.76.

The work of widening and deepening the draw at the Mystic River bridge between Charlestown and Chelsea has made necessary changes in the pipes which were laid at that point as inverted siphons under the channel. The greater depth and width of the draw made the use of a siphon impracticable, and a tunnel 6 feet in diameter and 145 feet in length is now being constructed, in which a line of 24-inch pipes will be laid. The invert of the tunnel is 46.8 feet below Boston city base.

The contract for the construction of this tunnel was made on August 2 with Charles A. Haskin of Boston, who had built a number of similar tunnels in this vicinity. The work was begun on August 20, and at the close of the year one shaft and nearly all of the horizontal portion of the tunnel were finished. About 45 feet of each shaft is composed of steel cylinders 8 feet in diameter, made of ½-inch plates. Three 9-foot lengths of cylinder were set up on the deck of a lighter, and partially lined with brick masonry. The 27-foot section of the shaft, weighing about 40 tons, was then lowered



TUNNEL UNDER MYSTIC RIVER—VIEW IN HEADING, SHOWING HYDRAULIC SHIELD.

into position and allowed to settle into the river bottom. Two additional sections of the cylinder were then bolted on and lined with brickwork. When this had been done, an air lock was bolted to the top of the shaft, the water forced out by compressed air, and the construction of the shaft and tunnel carried on under an air pressure of from 20 to 29 pounds. Below the bottom of the steel cylinders the shaft was lagged with circular wooden lagging 5 inches in thickness; and when the required depth was reached, Portland cement concrete, about 3 feet in thickness, was put in the bottom of the shaft, and the shaft was then lined with brickwork to the bottom of the lining already in place. A circular steel shield about 9 feet in diameter and 4½ feet in length was used in excavating the horizontal portion of the tunnel. The shield was forced ahead by means of hydraulic jacks as the material was excavated, and circular wooden lagging, 5 inches in thickness, cut from 2-inch spruce planks and having an inside diameter of 8 feet 2 inches, was placed in position as the shield advanced. When the lagging had been advanced from 8 to 10 feet beyond the completed masonry, it was lined with brickwork and washed with cement.

Where the tunnel is being built there is a depth of from 15 to 20 feet of water at low tide. In sinking the shaft on the Chelsea side of the channel, the material excavated was mud for a depth of 3 feet, clay for a further depth of 11 feet, and then sand and gravel for the remaining distance of 21 feet. The horizontal portion of the tunnel was excavated entirely through sand and gravel, containing some small boulders and a few pockets of clay. Much difficulty was experienced in preventing the escape of air and consequent flooding of the work; and when the drift was about 26 feet from the shaft a blow-out occurred, and work was delayed for a week. The shafts are surrounded by guards of oak piles securely fastened together with hard pine timber and bolts at their tops and at a point a few feet above low-water mark. The value of the work done on this contract on December 31 was about $15,000.

The lowering of the grade of Boylston Street in the town of Brookline made necessary the lowering of the 48-inch high-service main in that street for a distance of 400 feet. The pipes were lowered about 4 feet at the deepest point, and for the greater portion of the distance the trench was excavated in rock, requiring the removal of the pipes before the trench could be deepened. The work, which cost

$1,477.65, was done by the C. H. Eglee Company, who were constructing the street for the town of Brookline.

On account of the work of the Massachusetts Highway Commission in rebuilding the bridges over the Pines River on Broadway, in Revere and Saugus, it became necessary to relay 411 feet of 16-inch pipes crossing these bridges, and to reconstruct the boxes in which the pipes were enclosed. The wood work necessary on account of these changes was done by Joseph Ross & Son of Boston, who were the contractors for rebuilding the bridges. The iron work was furnished by the G. W. & F. Smith Iron Company, and the pipe work was done by the Maintenance Department. The cost of the work done at the crossing of the main branch of the river was $1,426.52, of which three-quarters was paid in equal proportion by the Highway Commission, the Lynn & Boston Railroad and the town of Revere. The cost of the work at the other bridges, which was borne by the Metropolitan Water Board, was $1,218.91.

The city of Boston, by filling Bennington Street across the marsh between the Revere town line and the solid ground on Breed's Island, caused the 12-inch pipe supplying the high-service district on Breed's Island to settle so badly that it became necessary on November 3 to discontinue the use of the main. Arrangements were made for supplying the district during the winter by pumping at the East Boston station. About 576 feet of the pipes were taken up, and it is probable that it will be necessary to relay at least 1,300 feet when the work of filling the street is finished.

ELECTROLYSIS.

Measurements have been made at different times during the year of the difference of potential between our pipes and the adjacent street railway tracks. These measurements show no noticeable change in conditions since previous measurements were made, but they indicate that in some localities large currents of electricity are constantly flowing through our pipes and passing off the pipes at many points, with difference of potential of from 8 to 10 volts. Examinations of the pipes have been made at several points, in order to ascertain whether any damage has been done by these electric currents. On Boylston Street in Cambridge, near the power station of the Boston Elevated Railway, the 48-inch pipe which was laid in 1896 was found to be pitted by electrolytic action to a depth of from ¼ to ⅜ of an inch. The 42-inch main laid three years ago on Broadway at the corner of Second Street in Chelsea, and the 16-inch main on Broad Street at the corner of Union Street in Lynn, which had been in use for eighteen months, were both found to be damaged to a serious extent from the same cause. There are without doubt many other points where destructive action is taking place, and, unless further measures are taken by the street railway companies to prevent their electric currents from returning through our pipes, or to greatly diminish the amount and force of such currents, the consequences will be very serious.

CLINTON SEWERAGE.

This plant was described in last year's report. The works have been in daily operation during the whole year, except on February 14 and March 2, at the time of the two freshets already mentioned, when the water in the river rose above the top of the man-holes on the sewers belonging to the town of Clinton, filled the sewers full and ran out of the overflow at the pumping station.

The regular force employed consists of 1 engineer at the pumping station, 1 attendant at the filter-beds and 1 additional employé, who assists both at the pumping station and at the filter-beds. At times, when additional assistance has been required, a force has been transferred temporarily from other parts of the work. The following are statistics relating to the operations at this pumping station: —

Daily average quantity of sewage pumped (gallons),	625,000
Daily average quantity of coal consumed (pounds),	918
Gallons pumped per pound of coal,	677
Number of days pumping,	363
Cost of pumping: —	
Labor,	$1,092 65
Fuel,	882 39
Repairs and supplies,	273 50
	$2,248 54
Cost per million gallons pumped,	9 91
Cost per million gallons raised one foot high,	21

Filter-beds.

During the warmer part of the year the sewage was applied to all of the 25 filter-beds, each being used on an average about once in seven days. During the winter only the 19 beds from which all soil had been removed were used. The works have continued to operate successfully ever since they were started, on September 15, 1899. The results have been better, however, in the last half of 1900 than before, as will be seen by the following results of chemical analyses.

[Parts per 100,000.]

	January to June, inclusive.	July to December, inclusive.	Whole Year.
Albuminoid ammonia, sewage,	1.2489	1.51	1.380
Albuminoid ammonia, effluent,	.1023	.0763	.089
Per cent. removed,	92	95	94
Oxygen consumed, sewage,	13.97	15.70	14.84
Oxygen consumed, effluent,	1.25	.93	1.09
Per cent. removed,	91	94	93

Although the percentage of organic matter removed was regarded as satisfactory in both halves of the year, there was a very great improvement in the nitrification in the second half, as will be seen by the following statement of the free ammonia and nitrates.

[Parts per 100,000.]

	January to June, inclusive.	July to December, inclusive.
Free ammonia, sewage,	3.3967	4.5033
Free ammonia, effluent,	1.5539	.5722
Per cent. removed,	54	87
Nitrogen as nitrates, effluent,	.1811	1.2788

The cost of maintaining the filter-beds has been as follows: —

Labor,	$1,955 51
Repairs and supplies,	73 58
Total,	$2,029 09
Cost per million gallons filtered,	8 95

GENERAL STATEMENT.

At the end of this, the fifth year since the letting of the first contract upon the Metropolitan Water Works, it is appropriate to review the work already done and to make a brief statement regarding future work.

Capacity of Sources. — The following table gives the capacity of the main sources of supply for the Metropolitan Water District and the estimated capacity of these sources when the works now in progress are completed: —

	Capacity of Main Sources (Gallons per Day).
1895,	48,000,000
1898,	105,000,000
1900,	110,000,000
When works are completed,	173,000,000

Storage Reservoirs. — The amount of storage capacity available in 1895 and the increase resulting and to result from the operations of the Metropolitan Water Board are as follows: —

	Capacity of Storage Reservoirs (Gallons).
1895,	8,605,000,000
1898,	15,858,500,000
When works are completed,	78,926,100,000

Aqueducts. — The Wachusett Aqueduct from the Nashua River to the Sudbury Reservoir has a capacity of 300,000,000 gallons per day; but from this reservoir to the Metropolitan Water District only the Sudbury and Cochituate aqueducts, taken from the city of Boston and having a combined capacity of 121,000,000 gallons per day, are available. It is the intention to begin in 1901 the construction of the Weston Aqueduct, having a capacity of 300,000,000 gallons per day, as an additional aqueduct for conveying water from the Sudbury Reservoir to the Metropolitan District. When this is completed, the total capacity of the aqueducts leading from the Sudbury and Cochituate sources to the District will be 421,000,000 gallons per day.

Pipe Systems. — In order to distribute the water to the different cities and towns, it was necessary to provide comprehensive pipe systems. The pipes laid in the different years, including comparatively short lengths acquired, were as follows: —

	Miles.
1896,	15.02
1897,	27.73
1898,	21.08
1899,	3.50
1900,	2.49
Total,	69.82

The westerly of the two pipes originally contemplated from Chestnut Hill Reservoir to Spot Pond was extended only to a point in Medford near Tufts College, and requires extension to Spot Pond; otherwise, the pipe system for the cities and towns now in the District is completed.

Pumping Stations. — In 1895 the city of Boston had two large pumping stations, one at Chestnut Hill, having a total pumping capacity of 36,000,000 gallons, and the Mystic pumping station in West Medford, having a total pumping capacity of 28,000,000 gallons; and there were 15 other small pumping stations, owned by the cities, towns and water companies. The use of all these except the Chestnut Hill and a small West Roxbury pumping station has been discontinued. The capacity of the original Chestnut Hill station has been nearly doubled, a new station has been built at Chestnut Hill to supply the district north of Charles River and to give an increased pressure in the low-service district of Boston, and a new pumping station has been constructed at Spot Pond. The total pumping capacity of these three large stations is 201,000,000 gallons per day. The consolidation of nearly all the pumping of the District at these stations and the installation of modern machinery has resulted in a very great saving in operating expenses. If the Spot Pond station had been in operation the whole year, the total cost of pumping in 1900 would have been about $83,000, which is $39,400 less than the total cost of pumping in 1897, when all of the local stations were in operation, notwithstanding the fact that in 1900 the quantity of water pumped was more than twice as great as in 1897. It will be necessary to build a permanent pumping station at Arlington in the place of the present temporary one, as soon as a contract can be placed upon favorable terms.

Distributing Reservoirs. — The names and available capacities of the distributing reservoirs and standpipes now controlled by the Board are as follows: —

NAME.	Service.	Capacity, in Gallons.	Remarks.
Spot Pond, ...	Low, ...	1,791,700,000	Original capacity, 758,000,000 gallons; enlarged by Board in 1899-1900.
Chestnut Hill Reservoir, .	Low, ...	300,000,000	Taken from city of Boston.
Fells Reservoir, . . .	Northern high, . .	41,400,000	Constructed by Board.
Mystic Reservoir, . .	Low, ...	26,200,000	Taken from city of Boston.
Waban Hill Reservoir, .	Southern high, . .	13,500,000	Purchased from city of Newton.
Forbes Hill Reservoir, .	Southern high, . .	5,000,000	Now under construction.
Forbes Hill standpipe, .	Southern high, . .	330,000	Constructed by Board.
Arlington standpipe, . .	Northern extra high, .	550,000	Purchased from town of Arlington.
Total, ...	. . . . . .	2,178,680,000	

Quality of Water. — The quality of the water in many portions of the District has been greatly improved by discontinuing polluted or objectionable sources, and the quality of the main supply of the city of Boston has also been very much improved. When the Wachusett Reservoir is completed, and the water can be stored for a longer time, a further considerable improvement is expected.

Value of Work done and remaining to be done. — The total expenditure on account of the Metropolitan Water Works, to December 31, 1900, was $20,027,416.84. Of this sum, $8,124,945.82 is chargeable to the purchase of existing water works or to the acquisition and completion of the Sudbury Reservoir. After deducting this sum from the total expenditure, there remains $11,902,471.02 expended upon the new works, which, according to the estimates of the State Board of Health, are to cost $24,027,800. It will therefore be seen that, if the works are completed for the amount estimated by the State Board of Health, — and it is expected that they will be completed within the estimates, — the future expenditures will substantially equal those already made.

Economy of a General Water Supply. — The financial results to the cities and towns of the District from the introduction of a general water supply have been very satisfactory. Notwithstanding the necessarily large expenditure for the Metropolitan Works, the abandoning of many local sources because the water was not of good quality, and the increase of 22 per cent. in the amount of water supplied per inhabitant since 1895, there has been no case, so far as I am aware, where it has been necessary to increase the water rates; on the other hand, in several instances there has been either a material reduction of water rates or an abolition of the charge for water supplied for public purposes, and to a greater extent than heretofore the cities and towns have paid for the extension of their works out of the water revenue, instead of by the issue of bonds.

The following financial statement covers all the cities and towns supplied with water from the Metropolitan Works except those supplied by water companies, and relates to the year 1899, because the reports for the year 1900 are not available: —

Surplus revenue in 1899,	$506,000
Reduction of water rates,	44,000
Abating charges formerly made for water used for public purposes,	225,000
Interest at 3½ per cent. on money paid by Commonwealth for existing water works, not credited to water department,	175,000
Total surplus revenue if no reduction had been made in charges for water, and interest had been credited to water department for money paid by the Commonwealth for existing works,	$950,000

This surplus would have been diminished by about $530,000 if the cities and towns had been assessed for the full annual cost of the works, instead of the smaller amount assessed under the existing law, so that the net surplus would have been $420,000.

GREAT INCREASE IN WATER CONSUMPTION.

The following table shows the consumption of water in the Metropolitan Water District, as now constituted, and Swampscott, for a series of years; also the estimated water consumption in the same territory for the next five years, if the rate of increase continues the same as the average rate from 1895 to 1900: —

Consumption of Water in the Metropolitan Water District and Swampscott, 1890–1900.

YEAR.	Water Consumption (Gallons per Day).	Population.	Consumption per Inhabitant (Gallons per Day).
1890,	47,555,000	648,802	73.3
1891,	52,676,000	668,665	78.8
1892,	57,687,000	688,528	83.8
1893,	65,590,000	708,391	92.6
1894,	64,782,000	728,254	89.0
1895,	68,882,000	748,117	92.1
1896,	77,688,000	770,680	100.8
1897,	80,144,000	793,244	101.0
1898,	82,914,000	815,807	101.6
1899,	91,299,000	838,371	108.9
1900,	97,114,000	860,934	112.8
1901,	102,760,000	Estimated consumption, based on the average annual increase from 1895 to 1900.	
1902,	108,406,000		
1903,	114,052,000		
1904,	119,699,000		
1905,	125,345,000		

NOTE. — The statistics given in this table include the whole Metropolitan Water District and Swampscott, while similar statistics already given in this report have included only the cities and towns supplied wholly or in part with water in 1900.

The table shows that the amount of water consumed has more than doubled in the last decade, and that this is due more to the increase in consumption per inhabitant, which has been 54 per cent. in the 10 years, than to the increase in population, which has been but 33 per cent. in the same time.

NEW AQUEDUCT REQUIRED.

The aqueducts now bringing water into the Metropolitan District have the following capacities, under ordinary conditions: —

	Gallons per Day.
Sudbury Aqueduct,	103,000,000
Cochituate Aqueduct,	18,000,000
	121,000,000

In comparing the capacity of an aqueduct with the water consumption, it is necessary to take into account that during the very cold weather in winter and during the months when water is used for sprinkling lawns the quantity of water to be conveyed is much larger than the average for the whole year. If it is assumed that the average consumption for the maximum month is 12½ per cent. in excess of the average for the year, then, upon the basis of the table given above, the average for the maximum month for each of the next five years would be as follows: —

Year.	Average for the Maximum Month (Gallons per Day).
1901,	115,605,000
1902,	121,957,000
1903,	128,309,000
1904,	134,661,000
1905,	141,013,000

I believe that the table shows, as nearly as I can estimate, the quantity of water which will require to be brought through the aqueducts, if no special measures are taken to restrict the excessive use and waste of water. In making the figures, no deduction has been made for nearly 3,000,000 gallons of water per day supplied to the city of Newton and the town of Hyde Park from local sources; but, on the other hand, no addition has been made for the increase in the consumption and waste of water in the low-service district of Boston, to be caused by the increased pressure, nor for the water which may be used by the towns which will probably be annexed to the District; and it is believed that these deductions and additions will balance each other.

By comparing the aqueduct capacity with the average consumption for the maximum month, it will be seen that the capacity will be reached in 1902. An aqueduct cannot be completed before 1903, even if begun early in 1901, but I believe that, with the large amount of water stored in Spot Pond and with the adoption of proper measures of inspection to prevent too great an increase in the water consumption, the supply can be maintained through the summer of 1903. The aqueduct should be completed in that year; and, as there is not sufficient money available for its completion, a further appropriation should be made in 1901.

WASTE AND EXCESSIVE USE OF WATER.

The statistics showing the great increase in the consumption of water in the last decade show that measures should be taken to prevent or restrict the waste and excessive use of water. The State Board of Health, after having the subject carefully considered by experts, reached the conclusion, in its report of 1895, that 100 gallons of water per inhabitant per day was a liberal quantity. This was in excess of the amount actually used in 1895, but was reached in 1896. If the consumption per inhabitant had been maintained at this rate, the amount of water consumed in 1900 would have been 86,000,000 gallons per day, or 11,000,000 gallons less than the actual consumption. The increase in daily consumption per year since 1895 would have been 2,256,000 gallons per day, instead of 5,646,000 gallons. If the increase in the next ten years continues at the same rate as in the last five years, the capacity of the new works will be equalled in 1910; whereas, if the consumption is reduced to 100 gallons per inhabitant, and maintained at that rate, the new supply will last for an additional eight or ten years without extension. If a new supply is required at the end of ten years, it will be necessary to begin the extension of works in six or seven years, or almost as soon as the works now in progress can be completed; and, in addition to the extension of works to new sources, there will be a demand for additional pumps and pipes for raising and conveying the largely increased quantities of water to the consumers.

It is time that measures should be taken to prevent or restrict the waste and excessive use of water; and there is no method by which this can be done so efficiently as by providing that water shall be furnished to each water taker through a meter. The results obtained in other places show that the water consumption can be diminished to a very large extent by the use of meters; and the experience of the city of Milwaukee in this respect is particularly instructive, as is to be seen by the following statement: —

YEAR.	Number of Services.	Number of Meters.	Percentage of Services Metered.	Daily Consumption per Inhabitant (Gallons).
1887, ...	13,248	1,728	13	113
1899, ...	38,191	25,639	67	85

The daily consumption of water per inhabitant in the Metropolitan Water District (113 gallons) is now the same as in Milwaukee in 1887.

Some legislation should be enacted by which the several cities and towns shall be induced or required to introduce meters, so that at the end of ten years all or nearly all of the water supplied to takers shall be furnished through meters.

Appended to this report are tables of contracts giving the amount of work done and other information, a statement of the cement tests made by the Dam and Aqueduct Department, a long series of tables relating to the maintenance of the Metropolitan Water Works, tables showing the length of main pipes and number of service pipes, meters and fire hydrants in the Metropolitan Water District, and a summary of statistics for 1900.

Respectfully submitted,

FREDERIC P. STEARNS,
Chief Engineer.

BOSTON, December 31, 1900.

APPENDIX.

APPENDIX No. 1.

STATEMENT OF IMPORTANT EVENTS IN THE CONSTRUCTION AND OPERATION OF THE METROPOLITAN WATER WORKS TO JANUARY 1, 1901.

Act authorizing and directing the State Board of Health to investigate and report on a system of metropolitan water supply,	June 9, 1893.
Report of State Board of Health recommending Metropolitan Water Works made to Legislature,	Feb. 7, 1895.
Metropolitan Water Act passed,	June 5, 1895.
Metropolitan Water Board organized,	July 15, 1895.
First contract made by the Metropolitan Water Board (water pipes),	Dec. 27, 1895.
First taking of land made (Sudbury Reservoir),	Jan. 4, 1896.
Sudbury Reservoir (partially constructed) taken from city of Boston,	Jan. 4, 1896.
First purchase of lands made (Shaw Place, in Boylston),	Jan. 29, 1896.
Wachusett Aqueduct, first contract made,	Feb. 14, 1896.
Laying of main water pipes begun,	May 11, 1896.
Chestnut Hill high-service pumping engine contracted for,	Jan. 1, 1897.
Sudbury Reservoir, partial filling begun,	Feb. 8, 1897.
Quincy admitted into Metropolitan Water District,	June 24, 1897.
Wachusett Reservoir, first contract made,	July 14, 1897.
Chestnut Hill high-service pumping station, addition begun,	Sept. 22, 1897.
Chestnut Hill low-service pumping station, contract for three 35,000,000-gallon pumping engines made,	Oct. 20, 1897.
City of Boston works and Spot Pond taken by Metropolitan Water Board,	Jan. 1, 1898.
Metropolitan Water Works first operated for supplying District,	Jan. 1, 1898.
Mystic system discontinued for regular water supply,	Jan. 1, 1898.
Spot Pond and Chestnut Hill Reservoir connected by main pipe line,	Jan. 13, 1898.
South Branch of Nashua River and Sandy Pond, waters taken,	Feb. 23, 1898.
Sandy Pond and Coachlace Pond taken,	Feb. 26, 1898.
Wachusett Aqueduct substantially completed,	March 7, 1898.
South Branch of Nashua River water diverted through the Wachusett Aqueduct,	March 7, 1898.
Sudbury Reservoir substantially filled,	April, 1898.
St. John's Catholic Cemetery in Clinton, agreement made for its acquisition and removal of bodies,	July 1, 1898.
Chestnut Hill low-service station, contract for building made,	Aug. 26, 1898.

Nahant admitted into Metropolitan Water District,	Sept. 13, 1898.
Spot Pond pumping station, contract for 20,000,000-gallon engine made,	Sept. 20, 1898.
Rosemary Brook siphon completed,	Nov. 17, 1898.
Swampscott, agreement made to supply with water,	Dec. 2, 1898.
Sudbury Reservoir substantially completed,	Dec. 9, 1898.
Chestnut Hill high-service station, Allis engine first operated,	Dec. 11, 1898.
Spot Pond pumping station, contract for building made,	Jan. 7, 1899.
Arlington admitted into Metropolitan Water District,	Jan. 31, 1899.
Spot Pond improvement begun,	April 10, 1899.
Marlborough Brook filter-beds first used,	June, 1899.
Fells Reservoir placed in service,	Aug. 31, 1899.
Clinton sewerage system first operated,	Sept. 15, 1899.
Spot Pond pumping station, 10,000,000-gallon engine, moved from Mystic pumping station, first operated,	March 7, 1900.
Chestnut Hill low-service station, first 35,000,000-gallon engine operated,	June 1, 1900.
Spot Pond, refilling of pond with water begun,	July 12, 1900.
Weston Aqueduct, first lands bought,	Sept. 10, 1900.
Spot Pond improvement substantially completed,	Sept. 15, 1900.
Wachusett Dam, contract made for,	Oct. 1, 1900.
Boston low-service district supplied with additional pressure,	Oct. 7, 1900.
Waban Hill Reservoir in Newton purchased,	Oct. 23, 1900.
Boston, settlement made for works taken,	Nov. 1, 1900.
Spot Pond pumping station, 20,000,000-gallon engine first operated,	Nov. 1, 1900.
Forbes Hill standpipe, Quincy, placed in service,	Dec. 31, 1900.

APPENDIX No. 2.

CONTRACTS MADE AND PENDING

Contracts made by the Metropolitan Water

	1.	2.	3.	Amount of Bid.		6.
	Number of Contract.	WORK.	Number of Bids.	4. Next to Lowest.	5. Lowest.	Contractor.
1	150	Excavating soil from Section 4 of the Wachusett Reservoir, and excavating and refilling at easterly portion of North Dike. (This contract was modified so as to include a portion of Contract No. 125, left unfinished by the contractor.)	9	$116,831 00	$116,546 00†	Moulton & O'Mahoney, Boston, Mass.
2	160*	Excavating soil from part of Section 5 of the Wachusett Reservoir, and excavating and refilling at westerly portion of North Dike, Clinton and Sterling, Mass.	10	83,812 30	81,476 84†	Cenedella Bros.,Milford, Mass.
3	166	Excavating soil from Section 6 of the Wachusett Reservoir, and building the easterly portion of the North Dike, Boylston, Clinton and West Boylston, Mass.	6	1,248,400 00	1,096,300 00†	Nawn & Brock, Boston, Mass.
4	176*	Excavating soil from Section 9 of the Wachusett Reservoir, and building a road in West Boylston and Boylston, Mass.	7	43,656 40	35,843 25†	Busch Bros., Buffalo, N. Y.
5	183	Excavating soil from Section 7 of the Wachusett Reservoir, and building a part of the westerly portion of the North Dike, Clinton and Boylston, Mass.	5	238,500 00†	230,685 00	Long & Little, Leominster, Mass.
6	186*	Transporting soil and earth from St. John's Catholic Cemetery to the North Dike, Clinton, Mass.	-	-	-	Martin Murphy, Clinton, Mass.

* Contract completed. † Contract based upon this bid.

APPENDIX No. 2.

DURING THE YEAR 1900.

Board relating to the Reservoir Department.

7.	8.	9.	10.	11.	12.	
Date of Contract.	Date for Completion of Contract.	Date of Final Estimate.	Prices of Principal Items of Contracts made in 1900.	Amount of Contract.	Value of Work done Dec. 31, 1900.	
April 10, '99,	June 1, '00,	-	-	$157,130 87	$157,130 87	1
June 1, '99,	Aug. 1, '00,	Sept. 20, '00,	- -	82,358 40	82,358 40	2
June 13, '99,	Dec. 1, '02,	-	- -	1,096,300 00	415,498 85	3
July 29, '99,	May 1, '00,	Sept. 5, '00,	- -	35,160 63	35,160 63	4
Dec. 12, '99,	July 1, '03,	-	- -	238,500 00	74,703 55	5
April 6, '00,	-	Sept. 28, '00,	For soil and earth transported and deposited previous to May 1, 1900, $0.15 per cu. yd.; for soil and earth transported and deposited subsequent to May 1, 1900, $0.175 per cu. yd.	3,176 60	3,176 60	6

CONTRACTS MADE AND PENDING

Contracts made by the Metropolitan Water Board

	1.	2.	3.	AMOUNT OF BID.		6.
	Number of Contract.	WORK.	Number of Bids.	4. Next to Lowest.	5. Lowest.	Contractor.
1	187*	Culverts on the Shrewsbury Road, West Boylston and Boylston, and on the Worcester Road, Boylston, Mass.	5	$5,055 05†	$4,839 50	Thomas H. Gill, Somerville, Mass.
2	189*	Improving part of Section 1 of the Shrewsbury Road, and surfacing the section with broken stone, West Boylston and Boylston, Mass.	5	14,599 00	14,425 00†	T. Stuart & Son, Newton, Mass.
3	190*	Surfacing Section 2 of the Shrewsbury Road with broken stone, Boylston, Mass.	4	11,880 00	11,839 00†	Fred E. Ellis, Melrose, Mass.
4	191*	Surfacing Section 3 of the Shrewsbury Road with broken stone, Boylston, Mass.	2	11,370 00	10,306 00†	Fred E. Ellis, Melrose, Mass.
5	197*	Excavating soil from part of Section 8 of the Wachusett Reservoir, and depositing it in the westerly portion of North Dike, Clinton and Sterling, Mass.	-‡	-‡	-‡	Newell & Snowling Construction Co., Uxbridge, Mass.
		Total, ...	. .	. . .	. . .	. . . .

* Contract completed. † Contract based upon this bid.

‡ The prices for this contract were fixed by the Board, and at the prices fixed the work was refused by two contractors engaged upon adjacent work before being awarded to the Newell & Snowling Construction Company.

DURING THE YEAR 1900 — *Continued.*

relating to the Reservoir Department — Concluded.

7. Date of Contract.	8. Date for Completion of Contract.	9. Date of Final Estimate.	10. Prices of Principal Items of Contracts made in 1900.	11. Amount of Contract.	12. Value of Work done Dec. 31, 1900.	
April 28, '00,	July 7, '00,	Sept. 11, '00,	For earth excavation, $0.50 per cu. yd.; for slope paving, $3.00 per cu. yd.; for rubble masonry, laid dry, $2 00 per cu. yd.; for rubble masonry laid in mortar, $5.00 per cu. yd.; for split-stone masonry laid in mortar, $22.00 per cu. yd.; for laying sewer pipe for culverts, 15-inch and 18-inch, $0.20 per lin. ft.; 24-inch, $0.23 per lin. ft.; 30-inch, $0.25 per lin. ft.; for laying cast-iron pipe for culverts, 12-inch, $0.12 per lin. ft.; 16-inch and 20-inch, $0.15 per lin. ft.	$6,930 21	$6,930 21	1
June 9, '00,	Oct. 1, '00,	Oct. 11, '00,	For earth excavation, $0.27 per cu. yd.; for rock excavation, $1.50 per cu. yd.; for laying 5-inch sewer pipe for side drains, $0.15 per lin. ft.; for shaping surface of road-bed, $0.05 per lin. ft.; for broken stone in place, $2.30 per ton of 2,000 lbs.	14,806 59	14,806 59	2
June 11, '00,	Oct. 1, '00,	Oct. 17, '00,	For earth excavation, $0.30 per cu. yd.; for shaping surface of road-bed, $0.07 per lin. ft.; for broken stone in place, $2.40 per ton of 2,000 lbs.	10,654 35	10,654 35	3
June 11, '00,	Oct. 1, '00,	Oct. 17, '00,	For earth excavation, $0.30 per cu. yd.; for shaping surface of road-bed, $0.07 per lin. ft.; for broken stone in place, $2.40 per ton of 2,000 lbs.	9,451 95	9,451 95	4
Aug. 7, '00,	Dec. 1, '00,	Dec. 15, '00,	For clearing and grubbing, $60.00 per acre; for soil and earth excavation, $0.30 per cu. yd.	28,763 90	28,763 90	5
. . .	. . . .	. . .	. . . .	$1,683,233 00	$838,634 90	

CONTRACTS MADE AND PENDING

Contracts made by the Metropolitan Water

	1. Number of Contract.	2. WORK.	3. Number of Bids.	AMOUNT OF BID. 4. Next to Lowest.	5. Lowest.	6. Contractor.
1	2-M*‡	Stone stairway and retaining wall at Echo Bridge, on the Sudbury Aqueduct, Newton, Mass.	4	$1,371 10	$1,308 00†	Webb Granite and Construction Co., Worcester, Mass.
2	3-M‡	Steel stairway at Echo Bridge.	2	1,498 00	1,165 00†	G. P. Bullard & Co., Boston, Mass.
		Total, ...	. .	. . .	. . .	. . . .

Contracts made by the Metropolitan Water Board

3	195	Wachusett Dam, Clinton, Mass.	11	$1,680,870 00	$1,603,635 00†	McArthur Bros. Co., Chicago, Ill.
		Total, ...	. .	. . .	. . .	. . . .

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* Contract completed. † Contract based upon this bid.

‡ This contract charged to maintenance.

DURING THE YEAR 1900 — *Continued.*

Board relating to the Sudbury Department.

7. Date of Contract.	8. Date for Completion of Contract.	9. Date of Final Estimate.	10. Prices of Principal Items of Contracts made in 1900.	11. Amount of Contract.	12. Value of Work done Dec. 31, 1900.	
Oct. 4, '00,	Nov. 20, '00,	Nov. 16, '00,	For earth and rotten ledge excavation, $1.00 per cu. yd.; for rock excavation, $3.50 per cu yd.; for rubble stone masonry, $7.50 per cu. yd.; for pointed coping, $3.50 per lin. ft.; for steps and landings, $250.00.	$1,367 27	$1,367 27	1
Oct. 19, '00,	Dec. 1, '00,	-	For whole work, $1,165.00, .	1,165 00	750 00	2
. . .	. . .	. . .	. . . .	$2,532 27	$2,117 27	

relating to the Dam and Aqueduct Department.

Oct. 1, '00,	Nov. 15, '04,	-	For earth excavation, $0.25, $0.35, $0.40, $0.50, $0.55, $0.65 and $1.00 per cu. yd.; for rock excavation, $0.90, $0.95, $1.00, $1.20, $2.00, $2.50 and $4.00 per cu. yd.; for rubble stone masonry, $3.80, $4 00, $4 20, $4.55 and $4.80 per cu. yd.; for ashlar masonry, $12.00, $12.50 and $13.50 per cu. yd.; for dimension stone masonry, $16.50 and $20.00 per cu. yd.; for face dressing of rough pointed work, $0.40 per sq. ft.; of fine pointed work, $0.50 per sq. ft.; of 6-cut work, $0.60 per sq. ft.; for brick masonry, $12.00, $13.00, $14.00 and $15.00 per cu. yd.; for Portland cement concrete masonry, $5 50 and $6.50 per cu. yd.; for natural cement concrete masonry, $3.75 and $4.35 per cu. yd.; for slope paving, $3.25 and $6.00 per cu. yd.; for laying 24-inch water pipe, $0.60 per lin. ft.; for hauling, caring for and putting in place iron and other metal work, $14.00 per ton of 2,000 lbs.	$1,603,635 00	$3,650 00	3
. .	. . .	. . .	. . . .	$1,603,635 00	$3,650 00	

CONTRACTS MADE AND PENDING

Contracts made by the Metropolitan Water Board

	1. Number of Contract.	2. WORK.	3. Number of Bids.	AMOUNT OF BID. 4. Next to Lowest.	5. Lowest.	6. Contractor.
1	46*	Pumping engine for the Chestnut Hill high-service pumping station in Boston, Mass.	-	-‡	-‡	The Edward P. Allis Co., Milwaukee, Wis.
2	72	3 pumping engines for the Chestnut Hill low-service pumping station in Boston, Mass.	5	$195,000 00	$186,500 00†	Holly Mfg. Co., Lockport, N. Y.
3	122	Pumping engine for the Spot Pond high-service pumping station in Stoneham, Mass.	4	64,000 00	62,500 00†	Holly Mfg. Co., Lockport, N. Y.
4	126	Low-service pumping station at Chestnut Hill Reservoir, Boston, Mass.	9	193,050 00	182,659 50†	Norcross Bros., Boston, Mass.
5	137	High-service pumping station and gate-house at Spot Pond, Stoneham, Mass.	10	110,822 50	108,480 00†	McNeil Bros., Boston, Mass.
6	141*	3 vertical fire-tube boilers at the Chestnut Hill low-service pumping station.	4	19,650 00†	19,050 00	The Atlantic Works, Boston, Mass.
7	142*	American mechanical stokers on 2 90-inch Belpaire boilers at the Chestnut Hill high-service pumping station.	1	-‡	-‡	The American Stoker Co., New York, N. Y.
8	143*	Hydraulic plunger elevator for Chestnut Hill low-service pumping station.	4	775 00	720 00†	Moore & Wyman Elevator and Machine Works, Boston, Mass.
9	148*	2 hand travelling cranes, one at Chestnut Hill low-service and one at Spot Pond high-service pumping stations.	4	5,594 00†	5,000 00	New England Structural Co., Boston, Mass.
10	158*	3 vertical fire-tube boilers at the Spot Pond high-service pumping station.	3	24,600 00	22,050 00†	Lake Erie Boiler Works, Buffalo, N. Y.
11	159*	Stable, shed and blacksmith shop at Glenwood pipe yard, Medford, Mass.	11	24,000 00	22,800 00†	W. L. Clark & Co., Boston, Mass.
12	163*	Green's improved fuel economizers at the Chestnut Hill low-service and the Spot Pond high-service pumping stations.	1	-‡	-‡	Fuel Economizer Co., Matteawan, N. Y.
13	167*	Masonry core walls and earth embankments for dams at Spot Pond.	13	24,815 00	23,032 50†	Brodhead Contracting Co., Easton, Pa.

* Contract completed. † Contract based upon this bid.

‡ Competitive bids were not received on this contract.

DURING THE YEAR 1900 — *Continued.*

relating to the Distribution Department.

7. Date of Contract.	8. Date for Completion of Contract.	9. Date of Final Estimate.	10. Prices of Principal Items of Contracts made in 1900.	11. Amount of Contract.	12. Value of Work done Dec. 31, 1900.	
Jan. 1, '97,	July 1, '98,	May 26, '00,	- -	$139,561 50	$139,561 50	1
Oct. 20, '97,	July 20, '99,	-	- -	136,500 00	130,000 00	2
Sept. 20, '98,	Jan. 20, '00,	-	- -	62,500 00	60,000 00	3
Aug. 26, '98,	July 15, '99,	-	- -	201,693 48	198,219 48	4
Jan. 7, '99,	Dec. 15, '99,	-	- -	121,000 00	118,000 00	5
Jan. 31, '99,	Oct. 1, '99,	June 15, '00,	- -	19,950 00	19,950 00	6
Jan. 28, '99,	-	July 14, '00,	- -	2,760 00	2,760 00	7
Jan. 14, '99,	-	May 25, '00,	- -	720 00	720 00	8
Mar. 31, '99,	Nov. 1, '99,	April 6, '00,	- -	5,544 00	5,544 00	9
May 8, '99,	Dec. 1, '99,	June 19, '00,	- -	22,388 75	22,388 75	10
May 25, '99,	Nov. 15, '99,	April 2, '00,	- -	21,808 82	21,808 82	11
May 10, '99,	Oct. 1, '99,	Mar. 1, '00,	- -	3,286 00	3,286 00	12
June 19, '99,	Oct. 1, '99,	Feb. 5, '00,	- -	34,004 75	34,004 75	13

CONTRACTS MADE AND PENDING

Contracts made by the Metropolitan Water Board

	1. Number of Contract.	2. WORK.	3. Number of Bids.	Amount of Bid. 4. Next to Lowest.	5. Lowest.	6. Contractor.
1	169*	Furnishing and erecting a steam engine for electric light plant at Chestnut Hill low-service pumping station.	4	$767 00	$741 00†	Fitchburg Steam Engine Co., Fitchburg, Mass.
2	170*	Furnishing and erecting an electric generator and switch-board for the Chestnut Hill low-service pumping station.	3	1,430 00	1,346 00†	Westinghouse Electric and Manufacturing Co., Pittsburg, Pa.
3	171	5 60-inch sluice gates with hydraulic lifts, 1 48-inch, 2 30-inch sluice gates with screw lifts, at Chestnut Hill Reservoir, Spot Pond and Forbes Hill Reservoir.	3	10,639 00	8,986 00†	The Atlantic Works, Boston, Mass.
4	173*	Gate-house at the northern high-service reservoir in the Middlesex Fells, Stoneham.	8	5,242 00†	4,900 00	W. L. Clark & Co., Boston, Mass.
5	174*	Improvement of Spot Pond, Section 1.	13	39,700 00	36,256 00†	Newell & Snowling Construction Co., Uxbridge, Mass.
6	175*	Improvement of Spot Pond, Section 2.	14	46,210 00	42,930 00†	Moulton & O'Mahoney, Boston, Mass.
7	177*	Improvement of Spot Pond, Section 3.	7	46,308 00†	45,717 50	Newell & Snowling Construction Co., Uxbridge, Mass.
8	178*	Gate chamber and connections at Chestnut Hill Reservoir.	9	21,481 00	19,657 50†	Baker & Judson, Gloversville, N. Y.
9	179*	Improvement of Spot Pond, Section 4.	6	78,630 00†	76,530 00	Moulton & O'Mahoney, Boston, Mass.
10	180*	Improvement of Spot Pond, Section 6.	12	44,345 00†	42,364 00	P. H. Fitzgerald, New London, Conn.
11	181*	Cast-iron floor plates, steel beams and cast-iron stop-plank grooves at Chestnut Hill Reservoir and Spot Pond.	3	4,325 00	3,680 00†	Coffin Valve Co., Boston, Mass.
12	184*	Southern gate-house at Spot Pond in Medford, Mass.	11	4,490 00	4,400 00†	John S. Jacobs & Son, Boston, Mass.
13	185	Gate-house at Chestnut Hill Reservoir, Boston, Mass.	9	10,399 00	9,974 00†	John S. Jacobs & Son, Boston, Mass.
14	188*	Improvement of Spot Pond, Section 7.	3	15,815 00	13,435 00†	Newell & Snowling Construction Co., Uxbridge, Mass.

* Contract completed. † Contract based upon this bid.

DURING THE YEAR 1900 — *Continued.*

relating to the Distribution Department — Continued.

7. Date of Contract.	8. Date for Completion of Contract.	9. Date of Final Estimate.	10. Prices of Principal Items of Contracts made in 1900.	11. Amount of Contract.	12. Value of Work done Dec. 31, 1900.	
June 8, '99,	Oct. 1, '99,	June 14, '00,	- -	$741 00	$741 00	1
June 10, '99,	Oct. 16, '99,	June 11, '00,	- -	1,346 00	1,346 00	2
June 23, '99,	Jan. 1, '00,	-	- -	9,262 00	9,219 00	3
July 18, '99,	Nov. 1, '99,	Feb. 23, '00,	- -	5,242 00	5,242 00	4
July 19, '99,	Dec. 15, '99,	Aug. 25, '00,	- -	49,458 28	49,458 28	5
July 19, '99,	July 15, '00,	Aug. 31, '00,	- -	45,692 05	45,692 05	6
Aug. 8, '99,	July 15, '00,	Sept. 18, '00,	- -	53,342 15	53,342 15	7
Aug. 7, '99,	Dec. 1, '99,	May 17, '00,	- -	19,502 34	19,502 34	8
Aug. 8, '99,	July 15, '00,	Oct. 19, '00,	- -	85,001 20	85,001 20	9
Aug. 24, '99,	Dec. 15, '99,	July 23, '00,	- -	52,557 44	52,557 44	10
Aug. 17, '99,	Dec. 1, '99,	Sept. 27, '00,	- -	3,680 00	3,680 00	11
April 21, '00,	Aug. 1, '00,	Oct. 29, '00,	For whole work, $4,400.00, .	4,400 00	4,400 00	12
April 21, '00,	Oct. 1, '00,	-	For whole work, $9,974.00, .	9,974 00	9,000 00	13
May 26, '00,	Aug. 15, '00,	Sept. 14, '00,	For earth excavation, $0.36½ per cu. yd.; for rock excavation, $1.50 per cu. yd.; for riprapping slopes, $0.98 per cu. yd.; for removing foundations and boundary walls, $2.00 per cu. yd.	16,665 93	16,665 93	14

CONTRACTS MADE AND PENDING

Contracts made by the Metropolitan Water Board

	1. Number of Contract.	2. WORK.	3. Number of Bids.	AMOUNT OF BID.		6. Contractor.
				4. Next to Lowest.	5. Lowest.	
1	192	Reservoir and foundation for standpipe at Forbes Hill, Quincy, Mass.	18	$36,855 00	$34,786 00†	Beckwith & Quackenbush, Herkimer and Mohawk, N. Y.
2	193*§	Laying water pipes across Chelsea Creek, between Boston and Chelsea.	3	14,279 00†	12,659 50	MacRitchie & Nichol, Chicago, Ill.
3	194	Standpipe on Forbes Hill, in Quincy, Mass.	4	4,498 00	4,425 00†	Walsh's Holyoke Steam Boiler Works, Holyoke, Mass.
4	196§	Tunnel under Mystic River, between Boston and Chelsea.	1	-‡	-‡	Charles A. Haskin, Boston, Mass.
5	198*	Furnishing and laying sewer pipes at Chestnut Hill Reservoir, Brighton, Mass.	1	-‡	-‡	Mirick & Wentworth, Malden, Mass.
6	1-M§	Horizontal return tubular boilers at the Chestnut Hill high-service pumping station, Boston.	2	6,550 00	4,900 00†	Lake Erie Boiler Works, Buffalo, N. Y.
		Total, ...	. .	. . .	. . .	. . . .

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* Contract completed.

† Contract based upon this bid.

‡ Competitive bids were not received on this contract.

§ This contract charged to maintenance.

DURING THE YEAR 1900 — *Continued.*

relating to the Distribution Department — Concluded.

7. Date of Contract.	8. Date for Completion of Contract.	9. Date of Final Estimate.	10. Prices of Principal Items of Contracts made in 1900.	11. Amount of Contract.	12. Value of Work done Dec. 31, 1900.	
July 7, '00,	Dec. 1, '00,	-	For earth excavation, $0.38 per cu. yd.; for concrete masonry, Class A, made with Portland cement mortar, $8.00 per cu. yd.; for concrete masonry, Class B, made with Portland cement mortar, $6.00 per cu. yd.; for concrete masonry, Class C, made with natural cement mortar, $5.25 per cu. yd.; for concrete masonry, Class D, made with Portland cement mortar, $6.00 per cu. yd.; for concrete masonry, Class E, made with Portland cement mortar, $7.00 per cu. yd.; for plastering of Portland cement, $0.25 per sq. yd.; for laying granolithic walk around reservoir, $1.89 per sq. yd.; for ashlar masonry, laid in mortar, $40.00 per cu. yd.; for dimension stone masonry, laid in mortar, $60 00 per cu. yd.	$34,736 00	$15,000 00	1
July 31, '00,	Nov. 1, '00,	Dec. 20, '00,	For laying 24-inch cast-iron pipes with ordinary joints, including cost of removing old 20-inch pipes, $8.00 per lin. ft.; for laying 24-inch cast-iron pipes with flexible joints, including cost of removing old 20-inch pipes, $8.00 per lin. ft.; for rebuilding fender guards, $3.00 per lin. ft.; for rebuilding pile dolphins, $85.00 per dolphin.	14,437 52	14,437 52	2
July 20, '00,	Nov. 1, '00,	-	For whole work, $4,425 00, .	4,529 72	4,529 72	3
Aug. 2, '00,	Nov. 1, '00,	-	For whole work, $19,550.00,	19,550 00	15,000 00	4
Aug. 15, '00,	Sept. 15, '00,	Sept. 20, '00,	For furnishing and laying 6-inch sewer pipe, $0.85 per lin. ft.; for man-holes for sewers, $50.00 per man-hole; for concrete masonry, $6.00 per cu. yd.; for rock excavation, $4.00 per cu. yd.	934 24	934 24	5
Sept. 26, '00,	Nov. 15, '00,	-	For whole work, $4,900.00, .	4,900 00	4,800 00	6
. . .	. . .	. . .	. . . .	$1,207,669 17	$1,166,792 17	

CONTRACTS MADE AND PENDING DURING THE YEAR 1900 — *Concluded.*

Summary of Contracts.*

	Approximate Amount of Contracts.	Value of Work done December 31, 1900.
Wachusett Reservoir, 11 contracts,	$1,683,233 00	$838,634 90
Wachusett Dam, 1 contract,	1,603,635 00	3,650 00
Distribution Department, 30 contracts,	1,168,781 65	1,132,554 65
Total of 42 contracts made and pending during the year 1900,	$4,455,649 65	$1,974,839 55
164 contracts completed in 1896, 1897, 1898 and 1899,	6,083,102 59	6,083,102 59
	$10,538,752 24	$8,057,942 14
Deduct for work done on 11 Sudbury Reservoir contracts by the city of Boston,	512,000 00	512,000 00
Total of 206 contracts,	$10,026,752 24	$7,545,942 14

* In this summary, contracts charged to maintenance are excluded.

APPENDIX No. 3.

TESTS OF CEMENT MADE AT THE OFFICE OF THE METROPOLITAN WATER BOARD, DAM AND AQUEDUCT DEPARTMENT, CLINTON, MASS.

The methods of testing were the same as described in Appendix No. 3, of the annual report of the Metropolitan Water Board for the year 1897. The tests are largely of cements used in 1896 and 1897 for the construction of the Wachusett Aqueduct, but the results of tests of cements used since that time are also included in the tables which follow.

Tabulation of Cement Tests for All Brands of Natural Cement, of which Nine Hundred Barrels or More were used on Construction Work by the Dam and Aqueduct and Reservoir Departments from 1896 to 1900, Inclusive.

BRAND.	Number of Barrels used.	Composition of Briquette.	FINENESS.			WIRE TESTS.		TENSILE STRENGTH.					
								ONE DAY.		SEVEN DAYS.		TWENTY-EIGHT DAYS.	
			Per Cent. Residue on No. 50 Sieve, 2,500 Meshes to Square Inch.	Per Cent. Residue on No. 100 Sieve, 10,000 Meshes to Square Inch.	Per Cent. Residue on No. 180 Sieve, 32,400 Meshes to Square Inch.	Minutes to bear Light Wire.	Minutes to bear Heavy Wire.	Number of Briquettes.	Pounds per Square Inch.	Number of Briquettes.	Pounds per Square Inch.	Number of Briquettes.	Pounds per Square Inch.
Beach,	8,380	Neat,	7.5	20.6	-	42	76	892	123	634	136	64	223
		1 to 1,	-	-	-	36	66	-	-	636	103	64	168
Hoffman,	45,345	Neat,	5.8	17.0	-	31	61	4,589	119	2,944	138	132	210
		1 to 1,	-	-	-	29	52	-	-	2,929	105	156	198
Norton,	60,877	Neat,	8.1	22.4	-	38	89	6,244	115	1,979	128	90	202
		1 to 1,	-	-	-	35	76	-	-	1,967	96	70	150
Union,	900	Neat,	1.3	9.9	18.1	10	26	183	164	193	167	137	187
		1 to 1,	-	-	-	10	20	-	-	153	156	36	206
Total,	115,502	Neat,	7.1	20.0	-	35	76	11,908	118	5,750	132	423	203
		1 to 1,	-	-	-	32	63	-	-	5,685	103	326	182

Tabulation of Cement Tests for All Brands of Natural Cement, etc. — Concluded.

BRAND.	Number of Barrels used.	Composition of Briquette.	TENSILE STRENGTH — Concluded.											
			THREE MONTHS.		SIX MONTHS.		ONE YEAR.		EIGHTEEN MONTHS.		TWO YEARS.		THREE YEARS.	
			Number of Briquettes.	Pounds per Square Inch.	Number of Briquettes.	Pounds per Square Inch.	Number of Briquettes.	Pounds per Square Inch.	Number of Briquettes.	Pounds per Square Inch.	Number of Briquettes.	Pounds per Square Inch.	Number of Briquettes.	Pounds per Square Inch.
Beach, ...	8,380	Neat, .	64	348	62	389	64	430	14	485	64	467	50	482
		1 to 1, .	64	317	62	319	64	315	14	331	64	316	50	349
Hoffman, ...	45,345	Neat, .	107	343	106	392	106	433	6	468	91	468	82	497
		1 to 1, .	107	315	117	366	106	338	6	316	91	329	82	347
Norton, ...	60,877	Neat, .	70	352	60	390	70	403	-	-	60	440	54	456
		1 to 1, .	70	301	60	291	70	307	-	-	60	295	54	314
Union, ...	900	Neat, .	67	273	27	317	62	411	12	393	22	409	10	474
		1 to 1, .	66	312	26	424	65	512	12	553	22	570	10	617
Total, ...	115,502	Neat, .	308	331	255	383	302	421	32	447	237	455	196	480
		1 to 1, .	307	312	265	344	305	363	32	411	237	339	196	352

Tabulation of Cement Tests for All Brands of Portland Cement, of which Nine Hundred Barrels or More were used on Construction Work by the Dam and Aqueduct and Reservoir Departments from 1896 to 1900, Inclusive.

BRAND.	Number of Barrels used.	Composition of Briquette.	FINENESS.			WIRE TESTS.		TENSILE STRENGTH.					
								ONE DAY.		SEVEN DAYS.		TWENTY-EIGHT DAYS.	
			Per Cent. Residue on No. 50 Sieve, 2,500 Meshes to Square Inch.	Per Cent. Residue on No. 100 Sieve, 10,000 Meshes to Square Inch.	Per Cent. Residue on No. 180 Sieve, 32,400 Meshes to Square Inch.	Minutes to bear Light Wire.	Minutes to bear Heavy Wire.	Number of Briquettes.	Pounds per Square Inch.	Number of Briquettes.	Pounds per Square Inch.	Number of Briquettes.	Pounds per Square Inch.
Atlas, ...	18,509	Neat, .	.4	10.0	24.7	88	424	1,928	400	994	686	115	739
		2 to 1, .	-	-	-	-	120	-	-	1,016	318	115	322
Brooks-Shoobridge, ...	5,706	Neat, .	1.0	11.5	26.1	82	295	506	211	595	452	55	452
		2 to 1, .	-	-	-	-	186	-	-	594	253	55	308
Giant, ...	15,394	Neat, .	1.0	9.9	21.9	22	125	1,575	293	682	452	70	511
		2 to 1, .	-	-	-	-	59	-	-	681	279	70	322
Iron Clad, ...	7,778	Neat, .	.3	9.0	26.0	70	230	824	434	408	571	45	619
		2 to 1, .	-	-	-	-	146	-	-	398	308	46	331
Stettin-Girstow, ...	979	Neat, .	2.8	17.9	30.9	130	444	145	288	145	570	54	596
		2 to 1, .	-	-	-	-	252	-	-	145	373	58	361
West Kent, ...	3,394	Neat, .	1.7	18.6	31.1	5	88	449	178	449	356	59	456
		2 to 1, .	-	-	-	-	17	-	-	449	261	59	326
Total, ...	51,760	Neat, .	.8	10.7	24.7	60	269	5,427	335	3,273	530	398	584
		2 to 1, .	-	-	-	-	115	-	-	3,283	292	403	327

Tabulation of Cement Tests for All Brands of Portland Cement, etc. — Concluded.

BRAND.	Number of Barrels used.	Composition of Briquette.	TENSILE STRENGTH — Concluded.													
			THREE MONTHS.		SIX MONTHS.		NINE MONTHS.		ONE YEAR.		EIGHTEEN MONTHS.		TWO YEARS.		THREE YEARS.	
			Number of Briquettes.	Pounds per Square Inch.	Number of Briquettes.	Pounds per Square Inch.	Number of Briquettes.	Pounds per Square Inch.	Number of Briquettes.	Pounds per Square Inch.	Number of Briquettes.	Pounds per Square Inch.	Number of Briquettes.	Pounds per Square Inch.	Number of Briquettes.	Pounds per Square Inch.
Atlas, ...	18,509	Neat, .	85	777	85	788	65	830	80	823	55	833	65	791	49	792
		2 to 1, .	85	821	85	332	65	326	80	344	55	332	65	328	49	355
Brooks-Shoobridge, ...	5,706	Neat, .	55	540	55	592	-	-	55	678	5	674	50	689	50	684
		2 to 1, .	55	383	55	408	-	-	55	433	5	521	50	457	50	458
Giant, ...	15,394	Neat, .	60	555	60	567	55	584	55	595	55	598	50	610	30	601
		2 to 1, .	60	384	60	399	55	421	55	422	55	426	50	424	30	432
Iron Clad, ...	7,778	Neat, .	34	675	34	705	34	724	34	746	29	768	14	720	14	745
		2 to 1, .	34	369	34	394	34	404	34	418	29	395	14	450	14	419
Stettin-Girstow, ...	979	Neat, .	52	646	52	674	-	-	52	677	8	665	51	714	42	709
		2 to 1, .	58	379	58	372	-	-	52	357	8	370	53	340	42	332
West Kent, ...	3,394	Neat, .	59	524	59	547	-	-	59	597	19	586	59	589	51	570
		2 to 1, .	59	410	59	434	-	-	59	455	19	522	59	434	51	424
Total, ...	51,760	Neat, .	345	627	345	652	154	719	335	691	171	706	289	684	236	679
		2 to 1, .	351	371	351	385	154	377	335	400	171	401	291	396	236	401

APPENDIX No. 4.

TABLE No. 1. — *Monthly Rainfall in Inches at Various Places on the Metropolitan Water Works, in 1900.*

PLACE.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Princeton, ...	4.64	8.59	5.47	2.58	4.65	3.28	2.86	3.75	3.73	3.40	6.32	2.90	52.17
Jefferson, ...	4.39	8.60	6.35	3.12	4.62	3.98	3.58	2.79	2.77	3.35	6.77	3.20	53.47
Sterling, ...	4.19	8.76	6.22	2.33	4.26	3.84	2.61	2.90	3.47	2.98	6.21	3.17	50.94
South Clinton, ...	5.02	8.81	6.73	3.02	3.82	3.25	3.80	3.29	3.85	1.87	6.44	3.34	53.24
Sudbury Dam, ...	5.03	8.84	6.32	2.59	4.28	2.75	2.68	2.11	3.25	3.72	5.58	2.50	49.65
Framingham, ...	4.64	8.82	6.24	2.48	4.22	2.91	2.24	2.25	3.41	3.78	5.37	2.54	48.90
Ashland Dam, ...	4.94	9.12	6.17	2.43	4.06	3.27	2.50	2.45	3.31	3.65	5.97	2.81	50.68
Cordaville, ...	5.24	9.78	6.67	2.83	4.72	3.01	2.25	2.21	3.48	4.18	5.90	3.10	53.37
Lake Cochituate, ...	4.96	8.59	5.82	2.24	4.77	3.02	2.65	3.58	3.84	3.65	5.52	2.67	51.31
Chestnut Hill Reservoir, . .	4.38	8.74	5.03	2.24	5.41	2.90	2.68	2.15	4.12	3.79	5.30	2.85	49.59
Spot Pond, ...	4.95	7.44	4.81	1.96	4.98	2.26	1.87	2.18	3.58	3.50	4.59	2.29	44.41
Average of all, ...	4.76	8.74	5.98	2.53	4.53	3.18	2.70	2.70	3.53	3.44	5.81	2.85	50.70
Average, Nashua watershed, .	4.56	8.69	6.19	2.76	4.34	3.59	3.20	3.18	3.46	2.90	6.44	3.15	52.46
Average, Sudbury watershed,	4.96	9.14	6.35	2.58	4.32	2.99	2.42	2.26	3.36	3.83	5.70	2.74	50.65

TABLE NO. 2. — *Rainfall in Inches at Jefferson, Mass., in 1900.*

DAY OF MONTH.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1, ...	0.82‡	-	3.00§	-	-	-	-	-	-	-	-	-
2, ...	-	-	-	-	-	-	-	-	-	-	-	-
3, ...	-	-	-	0.40†	*	1.43†	-	-	-	-	-	-
4, ...	-	*	-	-	1.09†	-	-	-	-	-	-	*
5, ...	-	1.10§	0.07‡	-	-	-	-	-	-	-	-	2.35§
6, ...	-	-	*	-	-	-	-	0.13†	-	*	-	-
7, ...	*	-	0.61§	-	-	-	-	*	-	*	-	-
8, ...	0.23†	*	-	-	0.15†	-	0.19†	0.94†	-	*	*	-
9, ...	-	1.05†	-	-	0.21†	0.07†	-	-	-	*	2.80‖	-
10, ...	0.07†	-	-	-	-	-	-	0.06†	-	*	-	-
11, ...	*	-	-	-	-	0.06†	-	-	-	2.10†	-	-
12, ...	1.15‖	*	-	*	-	-	0.50†	-	-	-	-	-
13, ...	-	3.15†	-	0.67†	-	-	-	*	-	*	-	-
14, ...	*	-	-	-	-	0.44†	-	0.15†	-	*	-	-
15, ...	0.15‡	-	*	-	0.04†	-	0.15†	0.53†	-	0.54†	-	-
16, ...	0.29†	-	2.10‖	-	-	-	-	0.46†	1.04†	0.07†	-	0.02‡
17, ...	-	*	-	*	0.05†	0.07†	-	-	*	-	*	-
18, ...	-	0.98‡	-	*	*	-	0.41†	*	0.60†	-	*	-
19, ...	-	-	*	1.41†	*	-	-	0.37†	-	-	*	-
20, ...	*	-	0.37†	-	3.04†	-	-	-	*	-	*	-
21, ...	0.71†	-	-	-	0.04†	-	0.09†	-	0.50†	-	0.52§	-
22, ...	-	*	-	*	-	*	-	-	-	-	-	-
23, ...	-	1.11§	-	*	-	0.90†	-	-	-	*	0.20†	*
24, ...	-	*	-	0.55†	-	-	-	0.05†	-	0.17†	*	0.42†
25, ...	*	1.21§	-	-	-	-	*	-	-	-	*	-
26, ...	0.40‖	-	*	-	-	-	2.19†	-	-	-	*	-
27, ...	-	-	0.20‡	-	-	-	-	0.10†	0.38†	*	3.00§	-
28, ...	*	-	-	-	-	1.01†	-	-	-	0.47†	-	0.11‡
29, ...	1.05§	-	-	-	-	-	-	-	*	-	-	-
30, ...	-	-	-	0.09†	-	-	-	-	0.25†	-	0.25§	*
31, ...	0.02†	-	-	-	-	-	-	-	-	-	-	0.30†
Totals, . . .	4.39	8.60	6.35	3.12	4.62	3.98	3.53	2.79	2.77	3.35	6.77	3.20

Total for the year, 53.47 inches.

* Rainfall included in that of following day. † Rain. ‡ Snow.

§ Rain and snow. ‖ Rain, snow and hail.

TABLE No. 3. — *Rainfall in Inches at Framingham, Mass., in 1900.*

DAY OF MONTH.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1,	0.39‡	-	*	-	-	-	-	-	-	-	-	-
2,	-	-	2.68†	*	-	-	-	-	-	-	0.02†	-
3,	-	-	-	0.71†	1.60†	*	0.02†	-	-	-	-	-
4,	-	*	-	-	0.21†	1.08†	-	-	-	-	-	*
5,	-	1.08†	0.06‡	-	-	-	0.02†	-	-	-	-	1.82§
6,	-	-	*	-	-	-	0.07†	-	0.01†	-	-	-
7,	0.08†	-	0.52§	-	-	-	0.05†	*	-	-	*	-
8,	-	*	-	-	0.19†	*	-	0.57†	-	0.05†	0.08†	-
9,	-	0.92†	-	-	0.05†	0.12†	-	-	-	-	1.09§	-
10,	0.05†	-	-	-	-	-	-	0.02†	-	2.42†	-	-
11,	*	0.03‡	-	-	-	0.04†	-	-	-	0.07†	-	0.03‡
12,	1.24§	*	-	*	-	-	0.43†	0.03†	-	-	0.01†	-
13,	-	2.42†	-	0.62†	-	-	-	*	-	-	-	-
14,	0.17‡	-	-	0.02†	-	0.12†	-	0.22†	-	0.38†	-	-
15,	-	-	*	-	0.06†	-	-	0.60†	-	-	0.01‡	-
16,	0.12†	-	2.44§	-	-	-	-	0.32†	1.05†	0.03†	-	0.03‡
17,	-	*	-	*	0.04†	-	-	0.34†	*	-	0.01†	-
18,	-	1.18‡	-	*	*	-	-	0.09†	1.24†	-	*	-
19,	-	-	*	0.70†	2.04†	-	-	-	-	-	0.22†	-
20,	*	-	0.28†	-	-	-	-	-	0.02†	-	0.09†	-
21,	0.92†	*	-	-	0.03†	-	-	-	0.59†	-	-	-
22,	-	*	-	0.11†	-	*	-	-	-	-	-	-
23,	-	1.66†	-	*	-	1.24†	*	-	0.01†	0.08†	0.14†	0.20†
24,	-	*	-	0.26†	-	-	0.04†	0.05†	-	-	*	-
25,	*	1.36†	-	-	-	-	*	-	-	-	*	0.02†
26,	0.30†	-	*	-	-	-	1.61†	-	-	-	*	-
27,	-	-	0.26‡	-	-	0.03†	-	*	0.24†	-	3.15†	-
28,	*	0.17†	-	-	-	0.28†	-	0.01†	*	0.75†	-	0.07§
29,	1.35§	-	-	-	-	-	-	-	0.05†	-	0.01‡	-
30,	-	-	-	0.06†	-	-	-	-	0.20†	-	0.54†	*
31,	0.02‡	-	-	-	-	-	-	-	-	-	-	0.37†
Totals,	4.64	8.82	6.24	2.48	4.22	2.91	2.24	2.25	3.41	3.78	5.37	2.54

Total for the year, 48.90 inches.

* Rainfall included in that of following day. † Rain. ‡ Snow. § Rain and snow.

TABLE No. 4. — *Rainfall at Chestnut Hill Reservoir in 1900.*

DATE.	Inches.	Rain or Snow.	Duration.
Jan. 1,	0.45	Snow.	4.40 A.M. to 4.00 P.M.
Jan. 7,	0.11	Rain.	9.15 P.M. to 11.30 P.M.
Jan. 11,	1.45	Rain and snow.	9.30 A.M. to
Jan. 12,			9.30 A.M.
Jan. 14,	0.14	Snow.	6.45 P.M. to 11.00 P.M.
Jan. 16,	0.13	Rain.	9.10 A.M. to 11.30 A.M.
Jan. 18,	0.02	Rain.	9.10 P.M. to 9.30 P.M.
Jan. 20,	0.67	Rain.	2.00 A.M. to 5.30 P.M.
Jan. 25,	0.57	Rain.	9.10 A.M. to
Jan. 26,			6.30 A.M.
Jan. 28,	0.84	Snow and rain.	7.15 P.M. to
Jan. 29,			10.30 A.M.
Total,	4.38		
Feb. 4,	0.86	Rain and snow.	8.00 P.M. to
Feb. 5,			11.15 A.M.
Feb. 8,	0.76	Rain.	12.10 P.M. to
Feb. 9,			3.30 P.M.
Feb. 11,	2.08	Snow and rain.	5.30 A.M.
Feb. 12,			to
Feb. 13,			4.30 P.M.
Feb. 17,	1.20	Snow.	3.15 P.M. to
Feb. 18,			10.30 A.M.
Feb. 22,	2.14	Rain.	1.30 A.M. to
Feb. 23,			12.30 A.M.
Feb. 24,	1.70	Rain.	9.30 P.M. to
Feb. 25,			6.45 A.M.
Total,	8.74		
Mar. 1,	1.89	Rain.	6.45 A.M. to 7.30 P.M.
Mar. 5,	0.04	Snow.	1.00 A.M. to 6.00 A.M.
Mar. 6,	0.44	Snow and rain.	1.00 A.M. to 9.30 P.M.
Mar. 15,	2.19	Snow and rain.	5.20 P.M. to
Mar. 16,			2.00 P.M.
Mar. 19,	0.23	Rain.	5.30 P.M. to
Mar. 20,			6.30 A.M.
Mar. 26,	0.24	Snow.	4.30 P.M. to
Mar. 27,			3.00 A.M.
Total,	5.03		
Apr. 3,	0.46	Rain.	1.00 A.M. to 4.00 P.M.
Apr. 12,	0.55	Rain.	9.30 A.M. to
Apr. 13,			6.00 P.M.
Apr. 17,	0.74	Rain.	10.30 A M.
Apr. 18,			to
Apr. 19,			8.00 A.M.
Apr. 21,	0.38	Rain.	6 30 P.M.
Apr. 22,			to
Apr. 23,			9.00 P.M.
Apr. 28,	0.07	Rain.	7.00 P.M. to 10.00 P.M.
Apr. 30,	0.04	Rain.	7.15 P.M. to 9.00 P.M.
Total,	2.24		
May 3,	2.47	Rain.	1.00 A.M. to 3.00 P.M.
May 3,	0.08	Rain.	8.30 P.M. to
May 4,			5.00 A.M.
May 8,	0.08	Rain.	9.00 A.M. to 11.30 A.M.
May 8,	0.10	Rain.	8.45 P.M. to 10.00 P.M.
May 9,	0.16	Rain.	10.30 A.M. to 2.15 P.M.
May 15,	0.39	Rain.	7.05 P.M. to 10.30 P.M.
May 18,	2.02	Rain.	5.15 P.M. to
May 19,			5.30 P.M.
May 21,	0.11	Rain.	1.20 P.M. to 6.45 P.M.
Total,	5.41		
June 3,	1.15	Rain.	1.30 A.M. to 8.30 P.M.
June 8,	0.14	Rain.	3.30 P.M. to 10.30 P.M.
June 14,	0.08	Rain.	7.45 A.M. to 4.15 P.M.
June 22,	1.08	Rain.	3.05 P.M. to
June 23,			4.30 A.M.
June 28,	0.22	Rain.	1.00 P.M. to 1.30 P.M.
June 28,	0.23	Rain.	7.30 P.M. to 9.30 P.M.
Total,	2.90		

Table No. 4. — *Rainfall at Chestnut Hill Reservoir in 1900* — Concluded.

DATE.	Inches.	Rain or Snow.	Duration.
July 3,	0.05	Rain.	9.30 P.M. to 10.30 P.M.
July 6,	0.07	Rain.	11.15 A.M. to 12.10 P.M.
July 7,	0.02	Rain.	7.30 P.M. to 8.00 P.M.
July 9,	0.05	Rain.	6.30 P.M. to 7.00 P.M.
July 12,	0.56	Rain.	5.30 P.M. to 10.00 P.M.
July 18,	0.20	Rain.	2.10 P.M. to 2.20 P.M.
July 25,	1.73	Rain.	4.10 P.M. to
July 26,			5.30 P.M.
Total,	2.68		
Aug. 7,	0.33	Rain.	10.20 A.M. to
Aug. 8,			7.20 A.M.
Aug. 10,	0.10	Rain.	4.10 P.M. to 4.45 P.M.
Aug. 13,	0.34	Rain.	10.00 P.M. to
Aug. 14,			7.15 A.M.
Aug. 15,	0.39	Rain.	12.30 P.M. to 3.30 P.M.
Aug. 16,	0.72	Rain.	7.00 A.M. to 2.15 P.M.
Aug. 19,	0.07	Rain.	1.00 A.M. to 3.30 A.M.
Aug. 24,	0.03	Rain.	Showers during day.
Aug. 27,	0.17	Rain.	9.00 P.M. to
Aug. 28,			5.15 A.M.
Total,	2.15		
Sept. 15,	1.35	Rain.	11.45 P.M. to
Sept. 16,			1.15 P.M.
Sept. 17,	2.02	Rain.	5.20 P.M. to
Sept. 18,			9.30 A.M.
Sept. 21,	0.47	Rain.	9.15 P.M. to
Sept. 22,			3.00 A M.
Sept. 28,	0.12	Rain.	Showers during day.
Sept. 30,	0.16	Rain.	1.30 A.M. to 1.00 P.M.
Total,	4.12		
Oct. 7,	0.07	Rain.	Showers during day.
Oct. 8,	2.17	Rain.	6.20 P.M.
Oct. 9,			to
Oct. 10,			8.00 P.M.

DATE.	Inches.	Rain or Snow.	Duration.
Oct. 11,	0.17	Rain.	10.00 A.M. to 4.00 P.M.
Oct. 13,	0.56	Rain.	8.00 P.M. to
Oct. 14,			3.00 A.M.
Oct. 16,	0.17	Rain.	5.10 P.M. to 8.30 P.M.
Oct. 18,	0.04	Rain.	Showers.
Oct. 24,	0.08	Rain.	2.00 A.M. to 6.00 A.M.
Oct. 27,	0.53	Rain.	6.30 P.M.
Oct. 28,			to
Oct. 29,			8.30 A.M.
Total,	3.79		
Nov. 8,	0.41	Rain.	6.30 P.M. to
Nov. 9,			6.30 A.M.
Nov. 9,	0.49	Rain.	8.30 A.M. to 9.45 A.M.
Nov. 9,	0.13	Rain.	3.30 P.M. to 6.45 P.M.
Nov. 15,	0.03	Rain.	10.15 A.M. to 5.30 P.M.
Nov. 19,	0.25	Rain.	9.30 P.M. to
Nov. 20,			3.30 A.M.
Nov. 21,	0.07	Rain.	5.00 P.M. to 9.00 P.M.
Nov. 23,	0.08	Rain.	2.00 A.M. to 6.00 A.M.
Nov. 24,	2.93	Rain.	8.15 P.M.
Nov. 25,			to
Nov. 26,			4.00 P.M.
Nov. 27,	0.06	Rain and snow.	2.30 P.M. to 11.45 P.M.
Nov. 29,	0.85	Rain.	10.20 P.M. to
Nov. 30,			1.15 P.M.
Total,	5.30		
Dec. 4,	1.91	Rain and snow.	9.00 A.M. to
Dec. 5,			7.15 A.M.
Dec. 16,	0.05	Snow.	4.00 A.M. to 10.30 A.M.
Dec. 24,	0.31	Rain.	12.05 A.M. to 3.00 A.M.
Dec. 28,	0.08	Snow and rain.	10.00 A.M. to 4.10 P.M.
Dec. 30,	0.50	Rain.	8.30 P.M. to
Dec. 31,			11.30 A.M.
Total,	2.85		

Total rainfall for the year, 49.59 inches.

TABLE No. 5. — *Rainfall, in Inches, on the Sudbury Watershed,* 1875 to 1900.*

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Totals.
1875, ...	2.42	3.15	3.74	3.23	3.56	6.24	3.57	5.53	3.43	4.85	4.83	0.94	45.49
1876, ...	1.83	4.21	7.43	4.20	2.76	2.04	9.13	1.72	4.62	2.24	5.76	3.62	49.56
1877, ...	3.22	0.74	8.36	3.43	3.70	2.43	2.95	3.68	0.32	8.52	5.80	0.87	44.02
1878, ...	5.63	5.97	4.69	5.79	0.96	3.88	2.97	6.94	1.29	6.42	7.02	6.37	57.93
1879, ...	2.48	3.56	5.14	4.72	1.58	3.79	3.93	6.51	1.88	0.81	2.68	4.34	41.42
1880, ...	3.57	3.98	3.31	3.11	1.84	2.14	6.27	4.01	1.60	3.74	1.78	2.83	38.18
1881, ...	5.56	4.65	5.73	2.00	3.51	5.39	2.35	1.36	2.62	2.95	4.09	3.96	44.17
1882, ...	5.95	4.55	2.65	1.82	5.07	1.66	1.77	1.67	8.74	2.07	1.15	2.30	39.40
1883, ...	2.81	3.87	1.78	1.84	4.19	2.46	2.68	0.73	1.52	5.60	1.81	3.55	32.78
1884, ...	5.09	6.54	4.72	4.41	3.47	3.44	3.67	4.65	0.85	2.48	2.65	5.17	47.14
1885, ...	4.71	3.87	1.07	3.60	3.48	2.87	1.43	7.18	1.43	5.09	6.09	2.72	43.54
1886, ...	6.36	6.28	3.61	2.22	3.00	1.47	3.27	4.10	2.90	3.24	4.64	4.97	46.06
1887, ...	5.20	4.78	4.90	4.27	1.16	2.65	3.76	5.28	1.32	2.83	2.67	3.88	42.70
1888, ...	4.15	3.68	6.02	2.43	4.82	2.54	1.41	6.22	8.59	4.99	7.22	5.40	57.47
1889, ...	5.37	1.65	2.37	3.41	2.95	2.80	8.94	4.18	4.60	4.25	6.29	3.14	49.95
1890, ...	2.53	3.51	7.73	2.64	5.21	2.03	2.46	3.87	6.00	10.51	1.20	5.31	53.00
1891, ...	7.02	5.23	6.48	3.91	2.01	3.77	3.39	4.73	2.38	3.83	3.09	3.68	49.52
1892, ...	5.85	3.14	4.06	0.83	5.58	2.76	4.23	4.44	2.84	1.17	5.80	1.13	41.83
1893, ...	2.92	8.20	3.67	3.60	6.61	2.38	2.57	5.41	1.74	4.07	2.20	4.86	48.23
1894, ...	4.09	3.91	1.43	3.42	4.24	1.15	3.26	2.03	2.63	5.34	3.43	4.81	39.74
1895, ...	4.06	1.39	2.98	5.25	2.02	2.77	5.04	4.15	2.30	10.68	6.63	3.35	50.62
1896, ...	2.39	7.18	5.24	1.57	2.57	3.22	2.51	2.40	7.72	3.76	3.02	2.12	43.70
1897, ...	4.00	2.91	3.66	2.82	4.37	4.46	5.44	3.51	2.94	0.47	6.40	5.21	46.19
1898, ...	6.83	4.49	2.40	4.66	3.22	2.48	4.09	8.17	2.62	6.71	6.93	3.28	55,88
1899, ...	4.18	4.91	7.01	1.90	1.45	2.51	3.22	1.43	3.95	2.69	2.18	1.78	37.21
1900, ...	4.96	9.14	6.35	2.58	4.32	2.99	2.42	2.26	3.36	3.83	5.70	2.74	50.65
Totals, . . .	113.18	115.49	116.53	83.66	87.65	76.26	96.73	106.16	84.19	113.14	111.06	92.33	1,196.38
Averages, . . .	4.35	4.44	4.48	3.22	3.37	2.93	3.72	4.09	3.24	4.35	4.27	3.55	46.01

* Means of observations at several places, as follows: January, 1875, to April, 1876, Lake Cochituate; April to June, 1876, Lake Cochituate, Westborough and Hopkinton; June to December, 1876, Lake Cochituate, Southborough, Marlborough, Westborough and Hopkinton; December, 1876, to January, 1883, Framingham, Southborough, Marlborough, Westborough and Hopkinton; January, 1883, to January, 1884, Framingham and Southborough; January, 1884, to January, 1890, Framingham and Westborough; January, 1890, to May, 1898, Framingham and Ashland Dam; June, 1898, to December, 1900, Framingham, Ashland Dam, Cordaville and Sudbury Dam.

TABLE No. 6. — *Rainfall collected, in Inches, on the Sudbury Watershed, 1875 to 1900.*

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Totals.
1875, ...	0.184	2.411	2.862	5.263	2.119	1.501	0.573	0.706	0.358	1.152	2.248	1.041	20.418
1876, ...	1.147	2.282	7.911	5.683	2.031	0.383	0.326	0.723	0.818	0.417	1.878	0.809	23.908
1877, ...	1.174	1.529	8.586	4.132	2.482	1.031	0.360	0.216	0.103	1.127	2.447	2.300	25.487
1878, ...	3.228	3.972	6.256	2.807	2.487	0.873	0.229	0.848	0.277	0.921	2.922	5.667	30.487
1879, ...	1.249	2.756	4.156	5.379	1.987	0.713	0.281	0.705	0.243	0.126	0.355	0.825	18.775
1880, ...	2.000	2.982	2.451	2.017	0.917	0.303	0.315	0.212	0.138	0.181	0.354	0.312	12.182
1881, ...	0.740	2.491	7.142	2.669	1.721	2.309	0.493	0.264	0.340	0.331	0.682	1.383	20.565
1882, ...	2.213	3.872	5.064	1.497	2.304	0.913	0.154	0.099	0.529	0.534	0.362	0.561	18.102
1883, ...	0.597	1.664	2.873	2.330	1.678	0.518	0.206	0.140	0.157	0.331	0.354	0.345	11.188
1884, ...	1.775	4.742	6.752	4.925	1.838	0.719	0.399	0.458	0.076	0.148	0.302	1.650	23.784
1885, ...	2.203	2.182	2.805	3.133	2.383	0.735	0.111	0.429	0.209	0.599	2.033	2.094	18.916
1886, ...	2.606	7.734	3.672	3.361	1.285	0.350	0.206	0.168	0.203	0.260	1.161	1.819	22.825
1887, ...	4.619	4.558	5.116	4.522	1.799	0.714	0.204	0.382	0.191	0.339	0.636	1.147	24.227
1888, ...	1.878	3.255	5.775	4.566	2.912	0.728	0.209	0.677	1.994	3.566	4.761	5.428	35.749
1889, ...	4.963	1.926	2.388	2.434	1.569	1.128	1.130	2.554	1.422	2.194	3.351	3.997	29.056
1890, ...	2.237	2.463	6.498	3.236	2.437	0.980	0.191	0.235	0.790	4.053	2.097	1.776	26.993
1891, ...	5.383	5.616	7.944	4.138	1.039	0.714	0.266	0.290	0.350	0.375	0.526	0.971	27.612
1892, ...	3.335	1.574	3.488	1.504	2.245	0.739	0.382	0.500	0.396	0.224	1.204	0.865	16.456
1893, ...	0.773	2.485	5.789	3.668	5.143	0.759	0.282	0.322	0.187	0.395	0.550	1.421	21.774
1894, ...	1.236	1.596	3.992	2.832	1.498	0.723	0.287	0.373	0.258	0.668	1.442	1.277	16.182
1895, ...	1.844	0.871	4.299	4.341	1.134	0.301	0.411	0.409	0.153	2.460	4.794	3.179	24.196
1896, ...	1.933	4.466	6.841	2.579	0.641	0.689	0.170	0.102	0.669	1.055	1.137	1.171	21.453
1897, ...	1.507	1.718	4.575	2.615	1.632	1.661	1.174	1.053	0.315	0.168	1.570	2.827	20.815
1898, ...	2.922	4.869	4.645	3.158	2.222	0.915	0.411	1.974	0.637	2.069	3.429	3.208	30.459
1899, ...	4.082	2.225	7.501	4.351	0.911	0.114	0.035	—0.063	0.162	0.206	0.525	0.392	20.441
1900, ...	1.417	6.123	6.518	2.330	2.341	0.545	—0.032	—0.060	0.112	0.331	1.144	1.955	22.724
Totals, . . .	57.245	82.362	135.899	89.470	50.750	21.058	8.773	13.716	10.587	24.230	42.264	48.420	584.774
Averages, . . .	2.202	3.168	5.227	3.441	1.952	0.810	0.337	0.528	0.407	0.932	1.625	1.862	22.491

TABLE No. 7.—*Yield of the Sudbury Watershed in Gallons per-Day per Square Mile* from 1875 to 1900.*

MONTHS.	1875.	1876.	1877.	1878.	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.
January, ...	103,000	643,000	658,000	1,810,000	700,000	1,120,000	415,000	1,241,000	335,000	995,000	1,235,000	1,461,000	2,589,000
February, ...	1,496,000	1,368,000	949,000	2,465,000	1,711,000	1,787,000	1,546,000	2,403,000	1,033,000	2,842,000	1,354,000	4,801,000	2,829,000
March, ...	1,604,000	4,435,000	4,814,000	3,507,000	2,330,000	1,374,000	4,004,000	2,839,000	1,611,000	3,785,000	1,572,000	2,059,000	2,868,000
April, ...	3,049,000	3,292,000	2,394,000	1,626,000	3,116,000	1,169,000	1,546,000	867,000	1,350,000	2,853,000	1,815,000	1,947,000	2,620,000
May, ...	1,188,000	1,138,000	1,391,000	1,394,000	1,114,000	514,000	965,000	1,292,000	937,000	1,030,000	1,336,000	720,000	1,009,000
June, ...	870,000	222,000	597,000	506,000	413,000	175,000	1,338,000	529,000	300,000	416,000	426,000	203,000	413,000
July, ...	321,000	183,000	202,000	128,000	157,000	176,000	276,000	86,000	115,000	224,000	62,000	116,000	115,000
August, ...	396,000	405,000	121,000	476,000	395,000	119,000	148,000	55,000	79,000	257,000	240,000	94,000	214,000
September, ...	207,000	184,000	60,000	161,000	141,000	80,000	197,000	307,000	91,000	44,000	121,000	117,000	111,000
October, ...	646,000	234,000	631,000	516,000	71,900	102,000	186,000	299,000	186,000	83,000	336,000	146,000	190,000
November, ...	1,302,000	1,088,000	1,418,000	1,693,000	206,000	205,000	395,000	209,000	205,000	175,000	1,177,000	673,000	369,000
December, ...	584,000	453,000	1,290,000	3,177,000	463,000	175,000	775,000	315,000	194,000	925,000	1,174,000	1,020,000	643,000
Average for year, ...	972,000	1,135,000	1,214,000	1,452,000	894,000	578,000	979,000	862,000	533,000	1,129,000	901,000	1,087,000	1,154,000
Average for driest 6 months,	574,000	384,000	502,000	532,000	230,000	143,000	330,000	211,000	145,000	200,000	391,000	223,000	234,000

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* The area of the Sudbury watershed used in making up these records included water surfaces amounting to 1.9 per cent. of the whole area from 1875 to 1878 inclusive, and subsequently increased by the construction of storage reservoirs to 3.0 per cent. in 1879, 3.4 per cent. in 1885, 3.9 per cent in 1894 and 6.5 per cent. in 1898. The watershed also contains extensive areas of swampy land, which, though covered with water at times, are not included in the above percentages of water surfaces.

TABLE No. 7. — *Yield of the Sudbury Watershed in Gallons per Day per Square Mile* from 1875 to 1900* — Concluded.

MONTHS.	1888.	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	Mean for 26 years, 1875-1900.
January,	1,053,000	2,782,000	1,254,000	3,018,000	1,870,000	434,000	693,000	1,034,000	1,084,000	845,000	1,638,000	2,288,000	794,000	1,234,000
February,	1,950,000	1,196,000	1,529,000	3,486,000	943,000	1,542,000	991,000	541,000	2,676,000	1,067,000	3,022,000	1,381,000	3,800,000	1,950,000
March,	3,238,000	1,338,000	3,643,000	4,453,000	1,955,000	3,245,000	2,238,000	2,410,000	3,835,000	2,565,000	2,604,000	4,205,000	3,654,000	2,929,000
April,	2,645,000	1,410,000	1,875,000	2,397,000	871,000	2,125,000	1,640,000	2,515,000	1,494,000	1,515,000	1,829,000	2,521,000	1,350,000	1,993,000
May,	1,632,000	880,000	1,366,000	583,000	1,259,000	2,883,000	840,000	636,000	360,000	915,000	1,246,000	511,000	1,312,000	1,094,000
June,	421,000	653,000	568,000	413,000	428,000	440,000	419,000	174,000	399,000	962,000	530,000	66,000	316,000	469,000
July,	117,000	634,000	107,000	149,000	214,000	158,000	161,000	231,000	95,000	658,000	231,000	19,000	—18,000	189,000
August,	379,000	1,432,000	132,000	163,000	280,000	181,000	209,000	229,000	57,000	591,000	1,107,000	—35,000	—34,000	296,000
September,	1,155,000	823,000	457,000	203,000	229,000	108,000	150,000	89,000	388,000	182,000	369,000	94,000	65,000	236,000
October,	1,999,000	1,230,000	2,272,000	210,000	126,000	222,000	374,000	1,379,000	592,000	94,000	1,160,000	115,000	186,000	522,000
November,	2,758,000	1,941,000	1,215,000	305,000	697,000	319,000	836,000	2,777,000	659,000	909,000	1,986,000	304,000	663,000	942,000
December,	3,043,000	2,241,000	996,000	544,000	485,000	796,000	716,000	1,782,000	657,000	1,584,000	1,799,000	220,000	1,096,000	1,044,000
Average for year,	1,697,000	1,383,000	1,285,000	1,315,000	781,000	1,037,000	770,000	1,152,000	1,019,000	991,000	1,450,000	973,000	1,082,000	1,070,000
Average for driest 6 months,	953,000	944,000	747,000	239,000	327,000	237,000	356,000	460,000	314,000	564,000	777,000	93,000	194,000	440,000

*** The area of the Sudbury watershed used in making up these records included water surfaces amounting to 1.9 per cent. of the whole area from 1875 to 1878 inclusive, and subsequently increased by the construction of storage reservoirs to 3.0 per cent. in 1879, 3.4 per cent. in 1885, 3.9 per cent. in 1894 and 6.5 per cent. in 1898. The watershed also contains extensive areas of swampy land, which, though covered with water at times, are not included in the above percentages of water surfaces.**

TABLE NO. 8. — *Sudbury River. — Statistics of Flow of Water, Storage and Rainfall in 1900.*

[Watershed from 1875 to 1878 inclusive = 77.764 square miles; in 1879 and 1880 = 78.238 square miles; and from 1881 to 1900 inclusive = 75.2 square miles.]

MONTHS.	Quantity of Water received through Wachusett Aqueduct (Gallons per Day).	Quantity of Water discharged through Sudbury Aqueduct (Gallons per Day).	Quantity of Water used by Framingham Water Company (Gallons per Day).	Quantity of Water diverted from Watershed by Sewers, etc. (Gallons per Day).	Quantity of Water wasted into River below Lowest Dam (Gallons per Day).	STORAGE.		Total Flow of River (Gallons per Day).	Rainfall (Inches).	Rainfall collected (Inches).	Percentage of Rainfall collected.
						Gain (Gallons per Day).	Loss (Gallons per Day).				
January, . . .	63,894,000	97,248,000	436,000	458,000	5,874,000	19,594,000	-	59,716,000	4.96	1.417	28.6
February, . . .	81,635,000	80,204,000	421,000	1,107,000	122,603,000	163,093,000	-	285,793,000	9.14	6.123	67.0
March, ...	100,100,000	72,190,000	371,000	1,177,000	223,413,000	77,723,000	-	274,774,000	6.35	6.518	102.6
April, ...	83,237,000	85,123,000	363,000	1,080,000	77,990,000	20,164,000	-	101,483,000	2.58	2.330	90.3
May, ...	61,803,000	84,800,000	387,000	971,000	70,732,000	3,603,000	-	98,690,000	4.32	2.341	54.2
June, ...	64,003,000	89,933,000	470,000	847,000	15,317,000	-	18,307,000	23,757,000	2.99	0.545	18.2
July, ...	35,042,000	80,674,000	549,000	100,000	1,500,000	-	49,139,000	—1,358,000	2.42	—0.032	—1.3
August, . . .	27,297,000	80,126,000	481,000	-	1,500,000	-	57,349,000	—2,539,000	2.26	—0.060	—2.7
September, . . .	15,530,000	90,217,000	483,000	127,000	1,500,000	-	71,907,000	4,890,000	3.36	0.112	3.3
October, . . .	27,981,000	89,616,000	429,000	200,000	1,500,000	-	49,793,000	13,971,000	3.83	0.331	8.7
November, . . .	59,230,000	89,900,000	397,000	530,000	2,357,000	15,923,000	-	49,877,000	5.70	1.144	20.1
December, . . .	107,081,000	90,203,000	397,000	1,220,000	38,116,000	59,558,000	-	82,413,000	2.74	1.955	71.5
Totals, . . .	-	-	-	-	-	-	-	-	50.65	22.724	-
Average for year,	60,452,000	85,867,000	432,000	607,000	46,492,000	8,419,000	-	81,365,000	-	-	44.9

TABLE No. 9. — *Lake Cochituate. — Statistics of Flow of Water, Storage and Rainfall in 1900.*

[Watershed of lake = 18.87 square miles.*]

MONTHS.	Quantity of Water received from Dudley Pond (Gallons per Day).	Quantity of Water discharged through Cochituate Aqueduct (Gallons per Day).	Quantity of Water diverted from Watershed by Sewers, etc. (Gallons per Day).	Quantity of Water wasted at Outlet (Gallons per Day).	STORAGE. Gain (Gallons per Day).	STORAGE. Loss (Gallons per Day).	Quantity of Water collected in Lake (Gallons per Day).	Rainfall (Inches).	Rainfall collected (Inches).	Percentage of Rainfall collected.
January,	-	-	352,000	-	12,574,000	-	12,926,000	4.96	1.22	24.6
February,	-	14,282,000	1,264,000	12,879,000	22,014,000	-	50,439,000	8.59	4.31	50.1
March,	-	15,426,000†	1,597,000	32,922,000	-	916,000	49,029,000	5.82	4.64	79.6
April,	-	526,000‡	797,000	14,340,000	2,070,000	-	17,733,000	2.24	1.62	72.4
May,	-	-	800,000	19,051,000	168,000	-	20,019,000	4.77	1.89	39.7
June,	-	4,147,000	483,000	1,870,000	-	950,000	5,550,000	3.02	0.51	16.8
July,	2,465,000	22,358,000	194,000	-	-	16,516,000	3,571,000	2.65	0.34	12.7
August,	-	22,716,000	161,000	-	-	16,077,000	6,800,000	3.58	0.64	18.0
September,	-	20,407,000	270,000	-	-	12,870,000	7,807,000	3.84	0.71	18.6
October,	-	17,545,000	258,000	-	-	9,403,000	8,400,000	3.65	0.80	21.8
November,	-	13,473,000	460,000	-	-	673,000	13,260,000	5.52	1.21	22.0
December,	-	15,809,000	875,000	-	1,632,000	-	18,316,000	2.67	1.73	64.9
Totals,	-	-	-	-	-	-	-	51.31	19.62	-
Average for year,	209,000	12,236,000§	622,000	6,734,000	-	1,756,000	17,627,000	-	-	38.2

* Not including the watershed of Dudley Pond.

‡ All wasted from aqueduct.

† Including 823,000 gallons per day wasted from aqueduct.

§ Including 113,000 gallons per day wasted from aqueduct.

TABLE No. 10. — *Elevations of Water Surfaces of Reservoirs above Boston City Base at the Beginning of Each Month.*

DATES.	Chestnut Hill Reservoir. Ordinary High Water =134.00.	Lake Cochituate. High Water =144.36.	Dudley Pond. High Water =156.46.	Spot Pond High Water =163.00.	Farm Pond. High Water =159.25.	FRAMINGHAM RESERVOIR.			Ashland Reservoir. Flash Boards 225.23.	Sudbury Reservoir. Flash Boards 259.97.	Hopkinton Reservoir. Flash Boards 305.00.	Whitehall Reservoir. High Water =337.91.
						No. 1. Flash Boards 169.27.	No. 2. Flash Boards 177.12.	No. 3. Flash Boards 186.50.				
Jan. 1, 1900, .	134.47	139.78	153.12	144.20	158.52	157.60	175.01	184.01	195.21	245.06	280.54	337.07
Feb. 1, 1900, .	134.85	141.61	153.31	145.12	158.81	167.72	177.32	183.98	199.22	245.09	284.15	337.36
March 1, 1900, .	133.78	144.23	154.36	147.10	159.28	168.03	176.25	183.61	216.31	255.20	299.18	337.79
April 1, 1900, .	133.77	144.12	155.26	142.85	159.32	167.92	176.15	185.16	224.46	259.29	304.24	337.31
May 1, 1900, .	133.80 134.05	144.36	155.11	141.50	159.25	167.84	177.27	185.86	225.19	260.02	304.95	337.91
June 1, 1900, .	134.00	144.38	155.14	141.80	159.26	169.51	177.76	186.08	225.23	260.01	305.09	337.85
July 1, 1900, .	133.83 134.23	144.27	154.69	141.30	158.87	168.97	177.02	184.78	225.28	259.14	305.01	337.87
Aug. 1, 1900, .	133.01	142.13	151.73	142.33	158.94	168.38	176.81	184.78	224.05	256.24	302.41	337.58
Sept. 1, 1900, .	132.80	139.81	151.72	145.14	158.78	168.20	176.04	184.67	223.83	252.29	300.53	337.17
Oct. 1, 1900, .	132.92	137.84	151.67	149.49	158.51	168.07	175.56	184.79	217.80	247.74	296.70	336.22
Nov. 1, 1900, .	132.23	136.20	151.68	153.94	158.50	168.24	175.43	184.63	213.79	244.74	286.79	335.38
Dec. 1, 1900, .	132.44	136.08	151.95	158.08	158.75	169.48	177.73	183.78	209.81	247.83	287.38	334.04
Jan. 1, 1901, .	133.93	136.38	152.32	159.47	158.85	167.76	176.01	183.53	214.44	252.54	291.99	334.82

NOTE. — Where two elevations are given for Chestnut Hill Reservoir, the first refers to Bradlee Basin and the second to Lawrence Basin.

TABLE No. 11. — *Times when the Sudbury and Cochituate Aqueducts have been in Service, and the Sources from which the Supply for the Sudbury Aqueduct has been drawn.*

Sudbury Aqueduct: —

From 7.00 A.M. Jan. 1 to 7.00 A.M. Jan. 5, from Framingham Reservoirs Nos. 2 and 3.
From 7.00 A.M. Jan. 5 to 7.00 A.M. Jan. 24, from Framingham Reservoir No. 3.
From 7.00 A.M. Jan. 24 to 2.00 P.M. Feb. 9, from Framingham Reservoirs Nos. 2 and 3.
From 2.00 P.M. Feb. 9 to 12.00 P.M. May 3, from Framingham Reservoir No. 3.
From 6.00 P.M. May 4 to 12.00 P.M. May 21, from Framingham Reservoir No. 3.
From 6.00 P.M. May 22 to 10.30 P.M. May 28, from Framingham Reservoir No. 3.
From 4.30 P.M. May 29 to 9.00 P.M. June 6, from Framingham Reservoir No. 3.
From 3.00 P.M. June 7 to 11.30 A.M. June 19, from Framingham Reservoir No. 3.
From 11.30 A.M. June 19 to 12.30 P.M. July 28, from Framingham Reservoirs Nos. 2 and 3.
From 12.30 P.M. July 28 to 10.00 A.M. Aug. 9, from Framingham Reservoir No. 3.
From 10.00 A.M. Aug. 9 to 10.00 A.M. Aug. 15, from Framingham Reservoirs Nos. 2 and 3.
From 10.00 A.M. Aug. 15 to 10.00 A.M. Aug. 23, from Framingham Reservoir No. 3.
From 10.00 A.M. Aug. 23 to 1.30 P.M. Dec. 5, from Framingham Reservoirs Nos. 2 and 3.
From 1.30 P.M. Dec. 5 to 7.00 A.M. Jan. 1, 1901, from Framingham Reservoir No. 3.

Cochituate Aqueduct: —

From 7.00 A.M. Feb. 2 to 11.00 A.M. Mar. 28.
From 7.00 A.M. June 3 to 3.00 P.M. June 8.
From 7.00 A.M. June 28 to 7.00 A.M. Jan. 1, 1901.

TABLE No. 12.—*Average Daily Quantity of Water flowing through Aqueducts in 1900, by Months.*

MONTHS.	Wachusett Aqueduct (Gallons).	SUDBURY AQUEDUCT.			Cochituate Aqueduct (Gallons).
		From Framingham Reservoir No. 3 (Gallons).	From Framingham Reservoir No. 2 (Gallons).	Total (Gallons).	
January,	63,894,000	90,438,000	6,810,000	97,248,000	-
February,	81,635,000	77,243,000	2,961,000	80,204,000	14,282,000
March,	100,100,000	72,190,000	-	72,190,000	15,426,000
April,	83,237,000	85,123,000	-	85,123,000	526,000
May,	61,803,000	84,800,000	-	84,800,000	-
June,	64,003,000	85,493,000	4,440,000	89,933,000	4,147,000
July,	35,042,000	70,993,000	9,681,000	80,674,000	22,358,000
August,	27,297,000	75,713,000	4,413,000	80,126,000	22,716,000
September,	15,637,000	67,007,000	23,210,000	90,217,000	20,407,000
October,	27,981,000	57,616,000	32,000,000	89,616,000	17,545,000
November,	59,230,000	57,633,000	32,267,000	89,900,000	13,473,000
December,	107,081,000	86,487,000	3,716,000	90,203,000	15,809,000
Averages,	60,461,000	75,907,000	9,960,000	85,867,000	12,236,000

NOTE.—Slight discrepancies between the figures for flow in Wachusett Aqueduct in this table and those in Table No. 8 are due to taking account of quantities wasted in cleaning aqueduct, which were not discharged into Sudbury Reservoir.

The Wachusett Aqueduct discharges into Sudbury Reservoir, whence the water flows into Framingham Reservoir No. 3.

The total quantity flowing through the Sudbury and Cochituate aqueducts was discharged into Chestnut Hill Reservoir, except a small quantity which was wasted in cleaning the aqueducts.

TABLE No. 13.—*Statement of Operations of Engines Nos. 1 and 2 at Chestnut Hill High-service Pumping Station for the Year 1900.*

[These engines were designed for the high service, but were used during the entire year for low service, except as noted.]

MONTHS.	ENGINE No. 1.		ENGINE No. 2.		Total Amount pumped (Million Gallons).	Total Amount of Coal consumed (Pounds).	Total Amount of Ashes and Clinkers (Pounds).	Per Cent. of Ashes and Clinkers.	Quantity pumped per Pound of Coal, no Deduction for Heating or Lighting (Gallons).	Average Lift (Feet).	Duty in Foot-pounds per 100 Pounds of Coal, no Deduction for Heating or Lighting, 4 Per Cent. allowed for Slip.	Duty in Foot-pounds per 100 Pounds of Coal, on Basis of Plunger Displacement, no Deduction for Heating or Lighting.
	Total Pumping Time.	Amount pumped, 4 Per Cent. allowed for Slip (Million Gallons).	Total Pumping Time.	Amount pumped, 4 Per Cent. allowed for Slip (Million Gallons).								
	Hrs. Min.		Hrs Min.									
January,	101 35	40.97	648 05	242.67	283.64	157,126	15,191	9.7	1,805.18	41.69	62,690,000	65,450,000
February,	672 00	268.70	-	-	268.70	233,457	21,510	9.2	1,150.94	38.12	36,550,000	38,160,000
March,	507 10	210.15	108 05	43.64	253.79	225,604	20,654	9.2	1,124.94	33.45	31,350,000	32,730,000
April,	356 10	133.15	118 05	46.66	179.81	175,953	16,831	9.6	1,021.92	43.10	36,690,000	38,310,000
May,	195 45	86.39	195 15	86.18	172.57	114,733	10,655	9.3	1,504.10	46.85	58,700,000	61,290,000
June,	60 15	22.46	-	-	22.46	29,920	3,048	10.2	750.67	48.27	30,180,000	31,510,000
July,	385 30	144.91	-	-	144.91	104,937	9,670	9.2	1,380.92	50.68	58,300,000	60,870,000
August,	90 30	39.94	-	-	39.94	51,022	5,750	11.3	782.80	67.85	44,240,000	46,190,000
September,	54 00	25.50	-	-	25.50	25,463	3,118	12.2	1,001.45	68.26	56,940,000	59,450,000
October (high service),	65 10	23.13	-	-	23.13	57,686	5,071	8.8	400.96	126.51	42,250,000	44,110,000
November (high service),	117 20	40.28	-	-	40.28	99,141	9,235	9.3	406.29	123.65	41,850,000	43,700,000
December,	-	-	-	-	-	-	-	-	-	-	-	-
Totals and averages, high service,	182 30	63.41	-	-	63.41	156,827	14,306	9.1	404.33	125.08	42,130,000	43,990,000
Totals and averages, low service,	2,422 55	972.17	1,069 30	419.15	1,391.32	1,118,215	106,427	9.5	1,244.23	48.70	50,470,000	52,700,000

TABLE No. 14. — *Statement of Operations of Engine No. 3 at Chestnut Hill High-service Pumping Station for the Year 1900.*

[This engine was designed for the high service, but was used for low service, except where noted.]

MONTHS.	Total Pumping Time.		Amount pumped, 3 Per Cent. allowed for Slip (Million Gallons).	Amount of Coal consumed (Pounds).	Coal consumed by Reserve Boiler, which also furnished Steam for Electric Lighting Plant (Pounds).	Amount of Ashes and Clinkers (Pounds).	Per Cent. of Ashes and Clinkers.	Quantity pumped per Pound of Coal, no Deduction for Heating or Lighting (Gallons).	Average Lift (Feet).	Duty in Foot-pounds per 100 Pounds of Coal, no Deduction for Heating or Lighting, 3 Per Cent. allowed for Slip.	Duty in Foot-pounds per 100 Pounds of Coal, on Basis of Plunger Displacement, no Deduction for Heating or Lighting.
	Hrs.	Min.									
January,	738	10	722.32	366,384	-	33,394	9.1	1,971.48	41.93	68,860,000	71,010,000
February,	672	00	658.25	236,700	-	19,249	8.1	2,780.95	38.97	90,280,000	93,100,000
March,	561	15	550.30	223,283	-	20,212	9.0	2,464.59	39.52	81,130,000	83,660,000
April (high service),	32	35	26.80	31,609	-	3,917	12.4	847.86	121.01	85,470,000	88,140,000
April,	649	30	590.26	211,287	-	20,108	9.5	2,793.64	40.13	93,390,000	96,300,000
May (high service),	29	20	30.38	57,529	-	2,416	4.2	528.08	123.37	54,270,000	55,960,000
May,	548	40	523.96	236,455	-	25,132	10.6	2,215.90	45.17	83,380,000	85,970,000
June,	316	50	315.43	144,589	40,449	14,894	10.3	2,181.56	44.65	81,140,000	83,670,000
July,	163	25	170.77	77,411	52,003	7,458	9.6	2,206.02	45.19	83,040,000	85,630,000
August,	90	50	86.28	55,664	75,062	5,252	9.4	1,550.01	69.21	89,360,000	92,150,000
September (high service),	7	40	6.75	9,573	-	-	-	705.11	121.71	71,490,000	73,720,000
September,	54	25	58.43	35,255	42,815	2,915	8.3	1,657.35	69.80	96,360,000	99,370,000
October (high service),	259	50	266.39	226,087	-	21,832	9.7	1,178.26	125.38	123,060,000	126,900,000
November (high service),	509	20	499.88	413,148	-	43,435	10.5	1,209.94	124.85	125,830,000	129,760,000
November,	117	15	113.32	75,602	5,681	8,223	10.9	1,498.90	71.95	89,840,000	92,640,000
December,	702	10	659.77	427,315	-	44,081	10.3	1,548.99	66.36	85,850,000	88,010,000
Totals and averages, high service,	838	45	830.20	737,941	-	71,600	9.7	1,125.02	123.26	115,510,000	119,110,000
Totals and averages, low service,	4,614	30	4,449.09	2,089,945	216,010	200,918	9.6	2,128.81	52.08	92,350,000	95,230,000

NOTE. — 9.45 million gallons of quantity pumped by Engine No. 3 to high service was diverted to low service through by-pass.

TABLE NO. 15. — *Statement of Operations of Engine No. 4 at Chestnut Hill High-service Pumping Station for the Year 1900.*

MONTHS.	Total Pumping Time.		Amount pumped, 1 Per Cent. allowed for Slip (Million Gallons).	Amount of Coal consumed (Pounds).	Amount of Ashes and Clinkers (Pounds).	Per Cent. of Ashes and Clinkers.	Quantity pumped per Pound of Coal, no Deduction for Heating or Lighting (Gallons).	Average Lift (Feet).	Duty in Foot-pounds per 100 Pounds of Coal, no Deduction for Heating or Lighting, 1 Per Cent. allowed for Slip.	Duty in Foot-pounds per 100 Pounds of Coal, on Basis of Plunger Displacement, no Deduction for Heating or Lighting.	SUMMARY OF ENGINES NOS. 1, 2, 3 AND 4.	
	Hrs.	Min.									Total Amount pumped, Allowance made for Slip (Million Gallons).	Daily Average Amount pumped (Million Gallons).
January,	741	35	633.65	405,455	32,101	7.9	1,562.81	122.09	158,940,000	160,550,000	1,639.61	52.89
February,	672	00	581.69	383,007	30,352	7.9	1,518.76	122.13	154,510,000	156,070,000	1,508.64	53.88
March,	727	45	638.61	440,183	44,105	10.0	1,450.78	122.54	148,090,000	149,590,000	1,442.70	46.54
April,	637	25	615.72	419,382	36,572	8.7	1,468.16	125.77	153,810,000	155,360,000	1,412.59	47.09
May,	702	35	818.66	526,905	42,314	8.0	1,553.71	125.90	162,940,000	164,590,000	1,545.57	49.86
June,	715	20	859.64	551,857	47,969	8.7	1,557.72	124.29	161,280,000	162,910,000	1,197.53	39.92
July,	740	45	877.73	583,006	47,794	8.2	1,505.52	127.01	159,280,000	160,890,000	1,193.41	38.50
August,	742	00	887.08	621,764	49,372	7.9	1,426.71	129.35	153,730,000	155,280,000	1,013.30	32.69
September,	710	35	843.68	619,102	51,258	8.3	1,362.75	125.52	142,490,000	143,930,000	934.36	31.15
October,	482	45	527.96	429,412	38,106	8.9	1,229.50	129.54	132,670,000	134,010,000	817.48	26.37
November,	209	50	204.99	138,756	10,767	7.8	1,477.34	124.31	152,980,000	154,530,000	858.47	28.62
December,	744	00	803.98	508,685	46,896	9.2	1,580.51	125.61	165,370,000	167,040,000	1,463.75	47.21
Totals and averages,	7,826	35	8,293.39	5,627,514	477,606	8.5	1,473.72	125.34	153,870,000	155,420,000	15,027.41	41.17

NOTE. — 266.83 million gallons pumped by Engine No. 4 was diverted to low service through by-pass.

TABLE NO. 16. — *Statement of Operations of Engines Nos. 5, 6 and 7 at Chestnut Hill Low-service Pumping Station for the Year 1900.*

MONTHS.	ENGINE No. 5.		ENGINE No. 6.		ENGINE No. 7.		Total Amount pumped (Million Gallons).	Daily Average Amount pumped (Million Gallons).	Total Amount of Coal consumed (Pounds).	Per Cent. of Ashes and Clinkers.	Quantity pumped per Pound of Coal, no Deduction for Heating or Lighting (Gallons).	AVERAGE LIFT (FEET).			Duty in Foot-pounds per 100 Pounds of Coal, no Deduction for Heating or Lighting, 1.55 Per Cent. allowed for Slip.	Duty in Foot-pounds per 100 Pounds of Coal, on Basis of Plunger Displacement, no Deduction for Heating or Lighting.
	Total Pumping Time.	Amount pumped, 1.55 Per Cent. allowed for Slip (Million Gallons).	Total Pumping Time.	Amount pumped, 1.55 Per Cent. allowed for Slip (Million Gallons).	Total Pumping Time.	Amount pumped, 1.55 Per Cent. allowed for Slip (Million Gallons).						Engine No. 5.	Engine No. 6.	Engine No. 7.		
	Hrs. Min.		Hrs. Min.		Hrs. Min.											
January,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
February,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
March,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
April,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
May,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
June,	377 00	502.56	-	-	-	-	502.56	16.75	209,654	8.7	2,397.09	40.21	-	-	80,290,000	81,530,000
July,	-	-	586 40	763.88	-	-	763.88	24.64	381,495	8.9	2,002.33	-	46.59	-	77,710,000	78,910,000
August,	452 05	587.91	282 00	373.77	-	-	961.68	31.02	413,758	9.1	2,324.26	49.58	49.58	-	95,990,000	97,480,000
September,	581 10	564.53	617 40	585.50	50 50	42.98	1,193.01	39.77	534,708	8.7	2,231.14	59.12	59.12	59.12	109,880,000	111,580,000
October,	726 40	803.42	680 10	734.80	570 20	609.17	2,147.39	69.27	798,540	9.3	2,706.09	57.77	59.10	41.55	120,880,000	122,750,000
November,	603 05	660.76	720 00	799.11	720 00	774.75	2,234.62	74.49	839,539	9.5	2,661.72	59.85	59.77	43.66	120,190,000	122,050,000
December,	351 25	378.17	424 35	476.79	714 40	773.04	1,628.00	52.52	606,963	9.4	2,682.21	48.91	54.83	37.73	101,290,000	102,860,000
Totals and averages,	3,091 25	3,497.35	3,311 05	3,733.85	2,055 50	2,199.94	9,431.14	25.84	3,779,657	9.2	2,495.24	52.57	54.83	45.52	107,710,000	109,880,000

TABLE No. 17. — *Statement of Operations of Engines Nos. 8 and 9 at Spot Pond Pumping Station for the Year 1900.*

ENGINE No. 8.

MONTHS.	Total Pumping Time.		Amount pumped, 2 Per Cent. allowed for Slip (Million Gallons).*	Amount of Coal consumed (Pounds).	Amount of Ashes and Clinkers (Pounds).	Per Cent. of Ashes and Clinkers.	Quantity pumped per Pound of Coal, no Deduction for Heating or Lighting (Gallons).	Average Lift (Feet).	Duty in Foot-pounds per 100 Pounds of Coal, no Deduction for Heating or Lighting, 2 Per Cent. allowed for Slip.	Duty in Foot-pounds per 100 Pounds o Coal, on Basis of Plunger Displacement, no Deduction for Heating or Lighting.
	Hrs.	Min.								
February,	2	12	.63	-	-	-	-	-	-	-
March,	203	40	73.71	117,017	12,492	10.7	629.91	134.40	70,520,000	71,970,000
April,	465	25	171.84	269,006	35,584	13.2	638.80	128.82	68,550,000	69,960,000
May,	493	00	186.45	278,049	37,424	13.5	670.57	128.40	71,720,000	73,200,000
June,	543	20	233.16	309,988	45,098	14.5	752.17	126.56	79,300,000	80,930,000
July,	633	25	284.47	345,113	50,636	14.7	824.28	126.04	86,540,000	88,320,000
August,	580	15	260.58	313,143	43,653	13.9	832.14	127.79	88,580,000	90,400,000
September,	543	00	239.13	309,228	36,108	11.7	773.31	126.61	81,560,000	83,240,000
October,	454	05	198.13	254,957	23,879	9.4	777.11	123.84	80,170,000	81,820,000
November,	185	00	80.00	99,377	9,867	9.9	805.02	116.25	77,960,000	79,570,000
December,	-		-	-	-	-	-	-	-	-
Totals and averages,	4,103	22	1,728.10	2,295,878	294,741	12.8	752.70	126.52	79,330,000	80,960,000

ENGINE No. 9.

MONTHS.	Total Pumping Time.		Amount pumped, 2 Per Cent. allowed for Slip (Million Gallons).*	Amount of Coal consumed (Pounds).	Amount of Ashes and Clinkers (Pounds).	Per Cent. of Ashes and Clinkers.	Quantity pumped per Pound of Coal, no Deduction for Heating or Lighting (Gallons).	Average Lift (Feet).	Duty in Foot-pounds per 100 Pounds of Coal, no Deduction for Heating or Lighting, 2 Per Cent. allowed for Slip.	Duty in Foot-pounds per 100 Pounds o Coal, on Basis of Plunger Displacement, no Deduction for Heating or Lighting.
November,	128	15	96.62	118,534	10,432	8.8	815.12	123.29	83,710,000	85,100,000
December,	235	10	190.41	207,147	18,586	9.0	919.20	121.70	93,180,000	94,730,000
Totals and averages,	363	25	287.03	325,681	29,018	8.9	881.32	122.50	89,930,000	91,420,000

* One and one-half per cent. allowed for slip of Engine No. 9.

NOTE. — No pumping done during the month of January.

TABLE No. 18. — *Statement of Operations at West Roxbury Pumping Station for the Year 1900.*

MONTHS.	Total Pumping Time.		Total Amount pumped, Allowance being made for Slip (Million Gallons).	Daily Average Amount pumped (Million Gallons).	Amount of Coal consumed (Pounds).	Amount of Ashes and Clinkers (Pounds).	Per Cent. of Ashes and Clinkers.	Quantity pumped per Pound of Coal (Gallons).
	Hrs.	Min.						
January, . . .	554	30	8.93	.288	50,055	10,010	20.0	178
February, . . .	479	00	7.63	.273	43,900	8,400	19.1	174
March, . . .	528	00	8.44	.272	48,370	8,910	18.4	174
April, . . .	515	30	10.08	.336	49,405	9,380	19.0	204
May, ...	584	45	10.26	.331	56,465	10,580	18.7	182
June, ...	681	00	12.86	.428	70,090	13,260	18.9	183
July, ...	803	15	15.59	.503	87,830	16,560	18.9	178
August, . . .	708	00	12.40	.400	68,825	13,330	19.4	180
September, . .	691	15	13.33	.444	74,810	13,110	17.5	178
October, . . .	624	00	10.93	.352	62,840	13,000	20.7	174
November, . .	567	00	9.22	.307	54,950	12,010	21.9	168
December, . . .	592	00	9.87	.318	62,700	13,460	21.5	157
Totals and averages,	7,328	15	129.54	.355	730,240	142,010	19.4	177

Average lift, 130.7 feet.

TABLE No. 19. — *Statement of Operations at Arlington Pumping Station for the Year 1900.*

MONTHS.	Total Pumping Time.		Total Amount pumped, Allowance being made for Slip (Million Gallons).	Daily Average Amount pumped (Million Gallons).	Amount of Coal consumed (Pounds).	Amount of Ashes and Clinkers (Pounds).	Per Cent. of Ashes and Clinkers.	Quantity pumped per Pound of Coal (Gallons).
	Hrs.	Min.						
January,* . . .	259	00	6.53	.211	62,800	No record kept.	-	104
February, . . .	257	30	7.30	.260	61,350		-	119
March, . . .	306	30	7.87	.254	59,460		-	132
April, ...	339	50	8.86	.295	55,000	7,380	13.4	161
May, ...	318	15	8.11	.262	49,700	6,905	13.9	163
June, ...	355	00	9.77	.326	54,200	6,827	12.6	180
July, ...	458	15	13.50	.435	71,400	7,970	11.2	189
August, . . .	381	00	10.95	.353	62,700	7,345	11.7	175
September, . .	596	00	†13.01	.434	75,950	8,054	10.6	171
October, . . .	369	30	‡8.64	.279	51,750	7,675	14.8	167
November, . . .	326	00	8.32	.277	49,600	6,485	13.1	168
December, . . .	338	00	8.23	.265	48,400	6,138	12.7	170
Totals and averages,	4,304	50	111.09	.304	702,310	64,779	12.5	158

Average lift, 270 feet.

* Engine started at 1.45 P.M. on January 1, under Metropolitan Water Works.

† Includes 2.43 million gallons furnished town of Lexington.

‡ Includes 0.38 million gallons furnished town of Lexington.

TABLE NO. 20. — *Average Daily Consumption of Water in Cities and Towns in the Metropolitan Water District and the Town of Swampscott, supplied wholly or in part by the Metropolitan Works (1900).*

MONTHS.	Supplied by Metropolitan Works (Million Gallons).	Supplied from Local Sources (Million Gallons).	Total (Million Gallons).	Estimated Population.	Consumption per Inhabitant (Gallons).
January,	96.572	.011	96.583	805,500	120.0
February,	95.590	-	95.590	807,200	118.0
March,	93.879	.634	94.513	808,900	117.0
April,	85.308	.702	86.010	810,600	106.0
May,	83.995	-	83.995	812,400	103.0
June,	94.064	-	94.064	814,100	116.0
July,	102.932	-	102.932	816,100	126.0
August,	98.326	-	98.326	818,100	120.0
September,	99.075	-	99.075	820,100	121.0
October,	94.704	-	94.704	822,100	115.0
November,	90.071	-	90.071	824,100	109.0
December,	94.486	-	94.486	826,100	114.0
For the year,	94.092	.113	94.205	815,400	115.5

In addition to the quantities above given, 2,909,000 gallons per day were supplied from local sources to Newton and Hyde Park, which are in the district. Including these places, the total consumption was 97,114,000 gallons per day, and the consumption per inhabitant 112.8 gallons per day.

TABLE NO. 21. — *Average Daily Consumption of Water from the Low Service (1900).*

MONTHS.	BOSTON.	SOMERVILLE, CHELSEA, EVERETT, MALDEN, MEDFORD, CHARLESTOWN, EAST BOSTON, MELROSE AND ARLINGTON.			Total Low-service Consumption (Million Gallons).
	Supply from Chestnut Hill Reservoir (Million Gallons).*	Pumped at Chestnut Hill Reservoir (Million Gallons).	Gravity Supply from Spot Pond (Million Gallons).	Gravity Supply to Medford from Wright's Pond (Million Gallons).	
January,	43.748	26.090	-	-	69.838
February,	41.545	26.505	-	-	68.050
March,	40.501	19.354	6.980	.634	67.469
April,	38.005	19.735	-	.702	58.442
May,	34.338	19.788	-	-	54.126
June,	37.414	21.441	-	-	58.855
July,	41.058	24.243	-	-	65.301
August,	39.567	24.276	-	-	63.843
September,	39.382	23.264	-	-	62.646
October,	39.171	22.738	-	-	61.909
November,	36.908	22.038	-	-	58.946
December,	35.005	27.627	-	-	62.632
For the year,	38.875	23.079	.593	.112	62.659

* Supply was furnished by gravity until October 10, and since that date by pumping.

TABLE No. 22. — *Average Daily Consumption of Water from the Southern High Service (1900).*

MONTHS.	Pumped at Chestnut Hill High-service Station for the Supply of Boston, Quincy, Watertown and Belmont (Million Gallons).*	MONTHS.	Pumped at Chestnut Hill High-service Station for the Supply of Boston, Quincy, Watertown and Belmont (Million Gallons).*
January, ...	20.152	August, ...	25.394
February, ...	20.502	September, ...	27.614
March, ...	20.328	October, ...	25.714
April, ...	21.081	November, ...	24.581
May, ...	23.379	December, ...	25.179
June, ...	26.687	For the year, ...	24.021
July, ...	27.472		

* This does not include water pumped from southern high-service mains for southern extra high service, at the West Roxbury pumping station.

TABLE No. 23. — *Average Daily Consumption of Water, in Million Gallons, from the Northern High Service, supplying Revere, Winthrop, Swampscott, Nahant and Breed's Island, and the Higher Portions of Chelsea, Everett, Malden, Medford, Melrose and Somerville (1900).*

MONTHS.	Pumped at Chelsea Station.	Pumped at East Boston Station.	Pumped at Malden Station.	Pumped at Somerville Station.	Pumped at Spot Pond Station.	Total Northern High-service Pumpage.	Storage in Fells Reservoir.	Total Northern High-service Consumption.
January, ...	1.470	-	2.356	2.320	-	6.146	—.064	6.082
February, ...	1.218	-	2.470	2.651	.023	6.362	+.143	6.505
March, ...	.890	-	1.459	1.588	2.378	6.315	—.125	6.190
April, ...	-	-	-	-	5.728	5.728	+.128	5.856
May, ...	-	-	-	-	6.015	6.015	—.118	5.897
June, ...	-	-	-	-	7.772	7.772	—.004	7.768
July, ...	-	-	-	-	9.176	9.176	+.044	9.220
August, ...	-	-	-	-	8.406	8.406	—.070	8.336
September, ...	-	-	-	-	7.971	7.971	—.027	7.944
October, ...	-	-	-	-	6.391	6.391	+.059	6.450
November, ...	-	.038	-	-	5.888	5.926	+.085	6.011
December, ...	-	.054	-	-	6.142	6.196	—.105	6.091
For the year, ...	.294	.008	.513	.535	5.521	6.871	—.006	6.865

TABLE No. 24. — *Average Daily Consumption of Water from the Southern Extra High Service in West Roxbury and the Northern Extra High Service in Arlington (1900).*

MONTHS.	Southern Extra High Service, West Roxbury (Gallons).	Northern Extra High Service, Arlington (Gallons).
January,	288,000	222,000
February,	273,000	260,000
March,	272,000	254,000
April,	336,000	295,000
May,	331,000	262,000
June,	428,000	326,000
July,	503,000	485,000
August,	400,000	353,000
September,	444,000	427,000*
October,	352,000	279,000*
November,	307,000	277,000
December,	318,000	265,000
For the year,	355,000	305,000

* Includes an average of 74,000 gallons per day during September and of 12,000 gallons per day during October furnished to the town of Lexington.

TABLE No. 25. — *Consumption of Water in the Metropolitan Water District, as constituted December 31, 1900, and the Town of Swampscott, 1893-1900.*

[Gallons per Day.]

MONTHS.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.
January,	74,703,000	67,034,000	68,464,000	82,350,000	84,833,000	83,270,000	95,816,000	99,385,000
February,	71,355,000	68,414,000	79,835,000	86,505,000	83,389,000	86,833,000	102,794,000	98,262,000
March,	67,147,000	62,188,000	68,998,000	85,584,000	82,164,000	84,794,000	89,527,000	97,064,000
April,	61,820,000	57,128,000	62,368,000	76,932,000	79,324,000	75,879,000	85,777,000	88,730,000
May,	60,500,000	60,060,000	64,542,000	72,642,000	76,112,000	75,886,000	88,577,000	86,935,000
June,	62,732,000	67,603,000	69,134,000	76,818,000	77,228,000	82,596,000	96,639,000	97,515,000
July,	68,507,000	72,903,000	68,928,000	79,102,000	84,765,000	87,259,000	95,852,000	106,550,000
August,	66,336,000	67,260,000	71,493,000	77,713,000	83,395,000	86,735,000	91,120,000	101,580,000
September,	64,075,000	66,462,000	73,026,000	73,467,000	83,575,000	87,496,000	90,627,000	102,347,000
October,	63,199,000	62,170,000	66,412,000	71,101,000	78,865,000	81,093,000	88,749,000	97,288,000
November,	60,647,000	61,695,000	64,312,000	71,309,000	72,121,000	77,540,000	85,907,000	92,643,000
December,	66,192,000	64,623,000	69,921,000	78,900,000	75,998,000	85,705,000	85,110,000	96,943,000
Average for the year,	65,590,000	64,782,000	68,882,000	77,688,000	80,144,000	82,914,000	91,299,000	97,114,000
Population,	708,391	728,254	748,117	770,680	793,244	815,807	838,371	860,934
Consumption per inhabitant,	92.6	89.0	92.1	100.8	101.0	101.6	108.9	112.8

Note relating to Chemical Examinations of Water, Tables Nos. 26–32.

The chemical examinations contained in the tables were made by the State Board of Health. Colors have been determined by the Nessler standard, but the corresponding values by the platinum standard are also given, for the purpose of comparison with colors determined in the laboratory of the Metropolitan Water Board, as given in subsequent tables. The odor recorded is taken in such a way that it is a much stronger odor than would be noticed in samples drawn directly from a tap or collected directly from a reservoir. In nearly all cases the samples are collected and examined monthly; in the case of the Sudbury Reservoir, however, they are made weekly.

TABLE No. 26. — *Chemical Examinations of Water from the Nashua River above the Temporary Dam at Clinton.*

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.				Odor.		Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
				Color.							Albuminoid.							
		Turbidity.	Sediment.	Nessler Standard.	Transformed to Platinum Standard.	Cold.	Hot.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1900.																	
29836	Jan. 1	Slight.	V. slight.	.34	.35	None.	Faintly vegetable.	4.50	1.30	.0012	.0222	.0202	.0020	.28	.0060	.0000	.54	1.7
30077	Jan. 31	Decided.	Slight.	.34	.35	None.	Faintly vegetable.	3.75	1.60	.0004	.0186	.0174	.0012	.20	.0060	.0001	.56	0.6
30802	Feb. 23	Decided.	Cons.	.32	.34	Faintly vegetable.	Distinctly vegetable.	2.85	1.15	.0032	.0180	.0166	.0014	.14	.0020	.0001	.47	0.5
30897	Apr. 2	Slight.	Slight.	.24	.29	None.	Faintly unpleasant.	2.65	0.85	.0002	.0160	.0130	.0030	.14	.0050	.0001	.40	0.8
31136	Apr. 30	Slight.	Cons.	.35	.36	None.	None.	3.20	1.20	.0002	.0156	.0128	.0028	.16	.0010	.0001	.50	0.8
31442	June 4	Decided.	Cons.	.35	.36	Faintly vegetable.	Distinctly vegetable.	3.55	1.15	.0030	.0172	.0142	.0030	.19	.0060	.0001	.50	0.8
31934	July 2	Slight.	Slight.	.35	.36	None.	Faintly vegetable.	4.60	1.00	.0024	.0204	.0162	.0042	.19	.0040	.0001	.47	0.8
32322	July 31	Slight.	Slight.	.26	.30	Very faintly unpleasant.	Very faintly unpleasant.	3.85	1.20	.0010	.0234	.0192	.0042	.18	.0020	.0001	.46	1.0
32819	Sept. 4	Slight.	Cons.	.20	.26	None.	Very faintly unpleasant.	3.65	1.05	.0016	.0134	.0112	.0022	.23	.0030	.0000	.26	1.0
33153	Oct. 1	Slight.	Slight.	.23	.28	None.	Faintly vegetable.	3.75	0.95	.0036	.0136	.0118	.0018	.22	.0030	.0001	.25	1.3
33582	Nov. 5	Slight.	Slight.	.30	.33	Faintly vegetable.	Distinctly vegetable.	4.20	1.30	.0022	.0220	.0188	.0032	.31	.0030	.0001	.38	1.1
33900	Dec. 3	Slight.	V. slight.	.56	.50	Faintly unpleasant.	Distinctly unpleasant.	4.20	1.40	.0014	.0206	.0190	.0016	.23	.0020	.0000	.81	1.0
Av.	....	....	....	.32	.34	....	....	3.73	1.18	.0017	.0184	.0159	.0025	.21	.0036	.0001	.47	0.9

TABLE No. 27. — *Chemical Examinations of Water from Framingham Reservoir No. 3.*

[Parts per 100,000.]

Number.	Date of Collection.	Appearance.				Odor.		Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Hardness.
				Color.							Albuminoid.							
		Turbidity.	Sediment.	Nessler Standard.	Transformed to Platinum Standard.	Cold.	Hot.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1900.																	
29821	Jan. 1	Slight.	Slight.	.30	.33	None.	Very faintly vegetable.	4.35	1.35	.0026	.0144	.0130	.0014	.28	.0040	.0001	.38	1.6
30074	Jan. 31	Decided.	Slight.	.23	.28	None.	Faintly vegetable.	4.65	1.50	.0028	.0156	.0134	.0022	.26	.0060	.0001	.38	2.0
30336	Feb. 28	Decided.	Cons.	.37	.37	Very faintly vegetable.	Very faintly vegetable.	3.95	1.35	.0042	.0220	.0172	.0048	.21	.0100	.0002	.56	1.0
30894	Apr. 2	Decided.	Cons.	.28	.32	Faintly vegetable.	Distinctly vegetable.	3.45	1.15	.0066	.0142	.0130	.0012	.19	.0070	.0001	.43	1.0
31127	Apr. 30	Slight.	Cons.	.17	.24	None.	Distinctly vegetable.	3.25	1.15	.0002	.0170	.0132	.0038	.27	.0050	.0000	.35	0.8
31432	June 4	V. slight.	Cons.	.21	.27	Faintly vegetable.	Distinctly vegetable.	3.55	0.95	.0022	.0164	.0140	.0024	.22	.0050	.0001	.36	1.1
31911	July 2	V. slight.	Slight.	.17	.24	None.	Faintly vegetable.	3.15	0.90	.0012	.0166	.0126	.0040	.20	.0030	.0001	.35	1.1
32309	July 31	V. slight.	V. slight.	.12	.20	None.	None.	3.25	1.00	.0002	.0186	.0138	.0048	.24	.0010	.0000	.41	1.0
32786	Sept. 4	V. slight.	Slight.	.10	.18	Faintly unpleasant.	Faintly unpleasant.	3.25	1.05	.0002	.0170	.0144	.0026	.21	.0010	.0000	.30	1.0
33184	Oct. 1	Slight.	Slight.	.12	.20	Distinctly vegetable.	Decidedly vegetable.	3.65	1.15	.0008	.0172	.0148	.0024	.22	.0010	.0000	.29	1.4
33560	Nov. 5	V. slight.	Slight.	.10	.18	None.	Faintly unpleasant.	3.35	1.15	.0024	.0180	.0150	.0030	.26	.0000	.0000	.26	1.3
33887	Dec. 3	Slight.	Cons.	.11	.19	None.	Faintly vegetable.	3.75	0.90	.0028	.0162	.0132	.0030	.26	.0020	.0001	.29	1.6
Av....	....	....	....	.19	.26	....	....	3.63	1.13	.0022	.0170	.0140	.0030	.23	.0037	.0001	.36	1.2

TABLE No. 28. — *Chemical Examination of Water from Lake Cochituate.*

[Parts per 100,000.]

Number.	Date of Collection.	APPEARANCE.				ODOR.		RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS		Oxygen Consumed.	Hardness.
				COLOR.							ALBUMINOID.							
		Turbidity.	Sediment.	Nessler Standard.	Transformed to Platinum Standard.	Cold.	Hot.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1900.																	
29822	Jan. 1	Slight.	Slight.	.19	.26	Very faintly vegetable.	Distinctly vegetable.	5.15	1.95	.0014	.0308	.0272	.0036	.53	.0050	.0001	.40	2.0
30075	Jan. 31	V. slight.	Slight.	.14	.21	None.	Faintly vegetable.	4.55	1.80	.0014	.0146	.0142	.0004	.38	.0060	.0001	.34	1.7
30337	Feb. 28	V. slight.	Slight.	.19	.26	Very faintly vegetable.	Very faintly vegetable.	4.20	1.35	.0024	.0176	.0144	.0032	.36	.0050	.0002	.33	1.7
30902	Apr. 2	V. slight.	Slight.	.13	.20	None.	Faintly vegetable.	4.15	1.15	.0032	.0196	.0176	.0020	.43	.0060	.0001	.36	1.7
31117	Apr. 30	V. slight.	Cons.	.13	.20	None.	Very faintly vegetable.	4.35	1.15	.0006	.0226	.0192	.0034	.42	.0030	.0001	.42	1.7
31431	June 4	V. slight.	Slight.	.20	.26	Faintly vegetable.	Distinctly vegetable.	4.45	1.50	.0032	.0230	.0200	.0030	.44	.0010	.0001	.37	1.7
31922	July 2	V. slight.	Cons.	.12	.20	Very faintly vegetable.	Distinctly nasturtium, anabæna.	4.40	1.15	.0020	.0212	.0170	.0042	.43	.0000	.0002	.40	2.0
32310	July 31	V. slight.	Slight.	.09	.17	None.	Very faintly vegetable.	4.65	1.55	.0004	.0254	.0198	.0056	.39	.0000	.0000	.42	1.7
32790	Sept. 4	V. slight.	Cons.	.10	.18	None.	Distinctly nasturtium, anabæna.	4.60	1.25	.0016	.0232	.0186	.0046	.44	.0020	.0000	.36	1.6
33135	Oct. 1	V. slight.	Cons.	.11	.19	Distinctly vegetable.	Faintly geranium, anabæna.	4.75	1.55	.0036	.0264	.0196	.0068	.42	.0010	.0000	.38	2.1
33568	Nov. 5	V. slight.	Slight.	.11	.19	Faintly vegetable.	Decidedly vegetable.	4.50	1.35	.0036	.0192	.0168	.0024	.47	.0020	.0001	.31	1.8
33886	Dec. 3	V. slight.	Cons.	.21	.27	Faintly vegetable.	Distinctly vegetable.	4.70	1.30	.0160	.0226	.0196	.0030	.44	.0010	.0003	.33	2.3
Av....	....	....	....	.14	.21	....	....	4.54	1.42	.0033	.0222	.0187	.0035	.43	.0027	.0001	.37	1.8

TABLE No. 29. — *Chemical Examinations of Water from Spot Pond, Stoneham.*

[Parts per 100,000.]

		APPEARANCE.				ODOR.		RESIDUE ON EVAPORATION.		AMMONIA.					NITROGEN AS			
				COLOR.							ALBUMINOID.							
Number.	Date of Collection.	Turbidity.	Sediment.	Nessler Standard.	Transformed to Platinum Standard.	Cold.	Hot.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Oxygen Consumed.	Hardness.
33717	**1900.** Nov. 20	Slight.	Slight.	.16	.23	Distinctly vegetable.	Distinctly vegetable and grassy.	5.25	1.30	.0024	.0198	.0186	.0012	.34	.0010	.0001	.32	2.3
33878	Dec. 3	None.	Slight.	.14	.21	Faintly unpleasant.	Distinctly unpleasant.	5.10	1.20	.0010	.0216	.0184	.0032	.29	.0020	.0000	.31	2.5
Av....	....	....	....	.15	.22	....	....	5.18	1.25	.0016	.0207	.0185	.0022	.32	.0015	.0001	.32	2.4

The filling of Spot Pond after its improvement was begun August 15. The above analyses were made after about 1,280,000,000 gallons of water had been pumped into the pond.

TABLE No. 30. — *Chemical Examinations of Water from a Faucet at the State House, Boston.*

[Parts per 100,000.]

Number.	Date of Collection.	APPEARANCE.				ODOR.		RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	COLOR.		Cold.	Hot.	Total.	Loss on Ignition.	Free.	ALBUMINOID.				Nitrates.	Nitrites.		
				Nessler Standard.	Transformed to Platinum Standard.						Total.	Dissolved.	Suspended.					
	1900.																	
29815	Jan. 1	Slight.	Slight.	.33	.35	None.	Faintly vegetable.	4.40	1.50	.0008	.0134	.0112	.0022	.30	.0070	.0001	.35	1.4
30078	Feb. 1	Slight.	Slight.	.25	.29	None.	Faintly vegetable.	4.70	1.50	.0010	.0136	.0120	.0016	.27	.0100	.0002	.38	1.4
30146	Feb. 9	Slight.	V. slight.	.25	.29	- -	- -	4.70	1.55	.0022	.0156	.0142	.0014	.30	.0110	.0001	.41	1.4
30332	Feb. 28	Slight.	V. slight.	.28	.32	None.	Faintly vegetable.	4.20	1.55	.0020	.0172	.0148	.0024	.28	.0150	.0002	.41	1.4
30887	Apr. 2	Slight.	Slight.	.27	.31	Faintly vegetable.	Distinctly vegetable.	3.45	1.10	.0034	.0152	.0130	.0022	.17	.0080	.0001	.42	1.1
31112	Apr. 30	V. slight.	Slight.	.20	.26	None.	Faintly vegetable.	3.45	1.05	.0012	.0146	.0114	.0032	.20	.0130	.0000	.36	0.8
31423	June 4	Slight.	Slight.	.20	.26	Faintly vegetable.	Distinctly vegetable.	3.30	0.95	.0014	.0150	.0134	.0016	.21	.0100	.0001	.34	0.8
31908	July 2	V. slight.	Slight.	.24	.29	None.	Faintly vegetable.	3.45	1.05	.0004	.0138	.0126	.0012	.22	.0080	.0000	.36	1.3
32288	July 30	V. slight.	Slight.	.17	.24	Very faintly vegetable.	Distinctly vegetable.	3.40	1.00	.0002	.0164	.0140	.0024	.24	.0020	.0001	.39	1.1
32844	Sept. 7	Slight.	Cons.	.21	.27	None.	Faintly vegetable.	3.50	1.10	.0002	.0174	.0154	.0020	.22	.0030	.0000	.37	1.4
33137	Oct. 1	Slight.	Cons.	.27	.31	Faintly vegetable.	Distinctly vegetable.	3.70	1.45	.0014	.0186	.0164	.0022	.23	.0050	.0000	.44	1.4
33551	Nov. 5	None.	V. slight.	.12	.20	Faintly vegetable.	Distinctly vegetable.	4.00	1.00	.0006	.0156	.0148	.0008	.39	.0050	.0000	.36	1.6
33901	Dec. 4	V. slight.	Slight.	.34	.35	None.	Faintly vegetable.	4.00	1.15	.0012	.0170	.0166	.0004	.30	.0050	.0001	.42	2.0
Av....	....	....	....	.24	.29	....	....	3.80	1.20	.0012	.0157	.0139	.0018	.25	.0076	.0001	.38	1.3

TABLE No. 31. — *Averages of Examinations of Water from Various Parts of the Metropolitan Water Works.* — *1900.*

[Parts per 100,000.]

LOCALITY.	COLOR.		RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS		Oxygen Consumed.	Hardness.
	Nessler Standard.	Platinum Standard.	Total.	Loss on Ignition.	Free.	ALBUMINOID.				Nitrates.	Nitrites.		
						Total.	Dis-solved.	Sus-pended.					
Quinepoxet River, Holden,	.51	.47	3.88	1.59	.0036	.0277	.0224	.0053	.21	.0047	.0002	.68	0.5
Stillwater River, Sterling,	.33	.35	3.07	1.28	.0025	.0156	.0140	.0016	.15	.0025	.0001	.53	0.7
Nashua River, Clinton,	.32	.34	3.73	1.18	.0017	.0184	.0159	.0025	.21	.0036	.0001	.47	0.9
Marlborough (Walker's) Brook,	.48	.45	17.72	4.50	.1010	.0553	.0360	.0193	2.02	.1463	.0046	.76	5.7
Marlborough Brook filter-beds, effluent,	.03	.06	11.29	-	.0096	.0071	-	-	1.48	.1828	.0005	.10	4.1
Sudbury Reservoir, surface,*	.22	.27	3.62	1.16	.0030	.0175	.0147	.0028	.22	.0054	.0001	.39	1.1
Sudbury Reservoir, mid-depth,*	.22	.27	3.62	1.15	.0035	.0162	.0138	.0024	.22	.0058	.0001	.39	1.1
Sudbury Reservoir, bottom,*	.22	.27	3.68	1.15	.0040	.0158	.0137	.0021	.22	.0059	.0001	.38	1.1
Framingham Reservoir No. 3, near dam,	.19	.26	3.63	1.13	.0022	.0170	.0140	.0030	.23	.0037	.0001	.36	1.2
Hopkinton Reservoir, influent,	1.00	.81	5.65	2.47	.0023	.0316	.0283	.0033	.39	.0013	.0000	1.29	1.5
Hopkinton Reservoir, surface,	.40	.39	3.37	1.35	.0026	.0210	.0177	.0033	.28	.0013	.0001	.59	0.8
Hopkinton Reservoir, bottom,	.42	.40	3.40	1.39	.0058	.0188	.0162	.0026	.27	.0025	.0001	.56	0.7
Ashland Reservoir, influent,	1.01	.82	5.42	2.63	.0011	.0303	.0286	.0017	.30	.0023	.0000	1.12	1.2
Ashland Reservoir, surface,	.47	.44	3.47	1.48	.0013	.0212	.0193	.0019	.23	.0022	.0001	.66	0.7
Ashland Reservoir, bottom,	.47	.44	3.27	1.32	.0024	.0198	.0185	.0013	.22	.0037	.0000	.64	0.8
Framingham Reservoir No. 2, influent,	.72	.59	4.46	1.87	.0019	.0253	.0230	.0023	.29	.0047	.0001	.81	0.9
Framingham Reservoir No. 2, near dam,	.57	.50	3.86	1.59	.0015	.0222	.0199	.0023	.27	.0023	.0000	.70	0.7
Lake Cochituate,	.14	.21	4.54	1.42	.0033	.0222	.0187	.0035	.43	.0027	.0001	.37	1.8
Terminal chamber, Sudbury Aqueduct,	.25	.29	3.82	1.25	.0028	.0171	.0148	.0023	.24	.0063	.0001	.41	1.2
Spot Pond,	.15	.22	5.18	1.25	.0016	.0207	.0185	.0022	.32	.0015	.0001	.32	2.4
Tap at State House,	.24	.29	3.80	1.20	.0012	.0157	.0139	.0018	.25	.0076	.0001	.38	1.3

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* These examinations were made weekly.

TABLE No. 32. — *Chemical Examinations of Water from a Faucet in Boston, from 1888 to 1900.*

[Parts per 100,000.]

YEARS.	COLOR.		RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS		Oxygen Consumed.	Hardness.
	Nessler Standard.	Platinum Standard	Total.	Loss on Ignition.	Free.	ALBUMINOID.				Nitrates.	Nitrites.		
						Total.	Dissolved.	Suspended.					
1888, . .	.38	.38	4.94	1.53	.0012	.0215	-	-	.40	.0183	.0002	-	-
1889, . .	.51	.46	4.71	1.43	.0005	.0199	.0176	.0023	.42	.0272	.0002	-	-
1890, . .	.35	.36	4.70	1.25	.0003	.0169	.0148	.0021	.42	.0241	.0001	-	2.2
1891, . .	.37	.38	4.39	1.63	.0005	.0161	.0136	.0025	.37	.0227	.0001	-	1.7
1892, . .	.37	.37	4.70	1.67	.0007	.0168	.0138	.0030	.41	.0210	.0001	-	1.9
1893, . .	.61	.53	4.54	1.84	.0010	.0174	.0147	.0027	.38	.0143	.0001	.60	1.8
1894, . .	.69	.58	4.64	1.83	.0006	.0169	.0150	.0019	.41	.0106	.0001	.63	1.7
1895, . .	.72	.59	4.90	2.02	.0006	.0197	.0175	.0022	.40	.0171	.0001	.69	0.7
1896, . .	.49	.45	4.29	1.67	.0005	.0165	.0142	.0023	.37	.0155	.0001	.56	1.4
1897, . .	.65	.55	4.82	1.84	.0009	.0193	.0177	.0016	.40	.0137	.0001	.64	1.6
1898, . .	.41	.40	4.19	1.60	.0008	.0152	.0136	.0016	.29	.0097	.0001	.44	1.4
1899, . .	.23	.28	3.70	1.30	.0006	.0136	.0122	.0014	.24	.0137	.0001	.35	1.1
1900, . .	.24	.29	3.80	1.20	.0012	.0157	.0139	.0018	.25	.0076	.0001	.38	1.3

TABLE No. 33. — *Microscopical Examinations of Water from Various Parts of the Metropolitan Water Works, 1900 (Means of Weekly Determinations).*

Nashua River at Head of Wachusett Aqueduct.

[Standard units per cubic centimeter.]

MONTHS.	ORGANISMS.	AMORPHOUS.	Principal Organisms.
	Surface.	Surface.	
January, ...	34	124	- -
February, ...	57	91	Infusoria.
March, ...	55	64	Infusoria.
April, ...	194	98	Diatomaceæ. Infusoria.
May, ...	272	118	Diatomaceæ. Infusoria. Rotifera.
June, ...	378	218	Diatomaceæ. Infusoria. Rotifera.
July, ...	360	171	Diatomaceæ. Chlorophyceæ. Infusoria. Rotifera.
August, ...	334	164	Diatomaceæ.
September, ...	146	211	Diatomaceæ. Chlorophyceæ. Infusoria. Rotifera.
October, ...	45	125	Infusoria.
November, ...	77	118	Infusoria.
December, ...	49	46	- -
Mean, ...	167	129	

TABLE No. 33 — *Continued.*

Sudbury Reservoir, 1900.

[Standard units per cubic centimeter.]

MONTHS.	ORGANISMS.				AMORPHOUS.				Principal Organisms in the Reservoir.
	Surface.	Mid-depth.	Bottom.	End of Open Channel.	Surface.	Mid-depth.	Bottom.	End of Open Channel.	
January,	120	83	68	74	86	112	103	106	Infusoria.
February,	350	150	50	56	77	70	78	197	Infusoria.
March,	348	323	213	43	65	73	121	68	Infusoria. Rotifera.
April,	802	595	511	120	109	90	98	107	Diatomaceæ. Infusoria.
May,	228	371	386	161	93	88	94	111	Diatomaceæ. Infusoria. Rotifera.
June,	363	171	157	424	59	87	78	188	Chlorophyceæ. Cyanophyceæ.
July,	681	348	279	765	76	76	112	224	Diatomaceæ. Chlorophyceæ. Cyanophyceæ.
August,	643	817	539	392	105	111	150	145	Diatomaceæ. Cyanophyceæ.
September,	724	712	623	253	131	141	148	162	Diatomaceæ. Cyanophyceæ.
October,	650	475	469	107	109	105	122	142	Diatomaceæ. Cyanophyceæ.
November,	877	790	822	85	56	54	59	68	Diatomaceæ. Cyanophyceæ.
December,	194	193	212	18	48	47	51	33	Diatomaceæ. Infusoria.
Mean,	498	419	361	208	85	88	101	129	

Framingham Reservoir No. 3, 1900.

[Standard units per cubic centimeter.]

MONTHS.	ORGANISMS.			AMORPHOUS.			Principal Organisms.
	Surface.	Mid-depth.	Bottom.	Surface.	Mid-depth.	Bottom.	
January,	124	116	119	104	112	104	Infusoria. Rotifera.
February,	179	61	136	86	87	95	Infusoria. Rotifera.
March,	163	176	117	78	86	84	Infusoria. Rotifera.
April,	820	710	724	125	152	162	Diatomaceæ. Chlorophyceæ. Infusoria.
May,	703	758	684	119	127	153	Diatomaceæ. Chlorophyceæ. Cyanophyceæ. Rotifera.
June,	1,582	1,321	633	80	98	117	Diatomaceæ. Chlorophyceæ. Cyanophyceæ. Infusoria.
July,	948	1,190	1,302	79	108	115	Diatomaceæ. Chlorophyceæ. Cyanophyceæ. Infusoria.
August,	573	693	862	116	138	178	Diatomaceæ. Chlorophyceæ. Cyanophyceæ. Infusoria.
September,	699	615	1,117	160	146	177	Diatomaceæ. Cyanophyceæ. Crenothrix.
October,	473	606	593	125	139	145	Diatomaceæ.
November,	869	720	859	61	57	53	Diatomaceæ. Infusoria. Rotifera.
December,	601	648	554	54	57	60	Diatomaceæ.
Mean,	645	635	642	99	109	120	

TABLE NO. 33 — *Continued.*

Whitehall Reservoir, 1900.

[Standard units per cubic centimeter.]

MONTHS.	ORGANISMS.	AMORPHOUS.	Principal Organisms.
	Surface.	Surface.	
January,	586	152	Diatomaceæ.
February,	525	117	Infusoria. Rotifera.
March,	1,236	183	Infusoria.
April,	501	102	Infusoria.
May,	258	108	Infusoria. Chlorophyceæ.
June,	319	102	Diatomaceæ. Chlorophyceæ. Cyanophyceæ. Infusoria.
July,	871	160	Chlorophyceæ. Infusoria. Rotifera.
August,	698	106	Diatomaceæ. Cyanophyceæ.
September,	196	97	Cyanophyceæ.
October,	170	83	Rotifera.
November,	213	98	Diatomaceæ.
December,	177	59	Infusoria. Rotifera.
Mean,	437	114	

Hopkinton Reservoir, 1900.

[Standard units per cubic centimeter.]

MONTHS.	ORGANISMS.				AMORPHOUS.				Principal Organisms in the Reservoir.
	Surface.	Mid-depth.	Bottom.	Inlet.	Surface.	Mid-depth.	Bottom.	Inlet.	
January,	2,312	1,209	1,168	59	91	102	119	62	Infusoria.
February,	518	454	514	60	69	57	62	68	Rotifera.
March,	640	485	359	192	59	54	70	34	Rotifera.
April,	1,381	852	612	289	97	89	104	120	Diatomaceæ. Chlorophyceæ. Infusoria. Rotifera.
May,	2,758	1,835	1,822	120	123	141	133	64	Diatomaceæ. Chlorophyceæ. Crenothrix. Infusoria.
June,	1,582	1,323	740	79	81	115	141	44	Diatomaceæ. Chlorophyceæ. Cyanophyceæ.
July,	607	325	537	355	69	86	138	54	Cyanophyceæ. Crenothrix.
August,	501	313	290	567	65	82	200	151	Cyanophyceæ.
September,	276	182	106	481	80	90	137	140	- -
October,	302	217	319	207	65	78	139	102	Crenothrix.
November,	511	549	508	169	81	83	80	106	Diatomaceæ. Infusoria. Rotifera.
December,	370	391	314	7	38	37	35	25	Infusoria. Rotifera.
Mean,	980	678	607	215	77	85	113	81	

TABLE NO. 33 — *Continued.*

Ashland Reservoir, 1900.

[Standard units per cubic centimeter.]

MONTHS.	Organisms.				Amorphous				Principal Organisms in the Reservoir.
	Surface.	Mid-depth.	Bottom.	Inlet.	Surface.	Mid-depth.	Bottom.	Inlet.	
January, . .	924	820	259	34	102	118	138	68	Infusoria. Rotifera.
February, .	338	242	222	56	88	79	117	125	Infusoria. Rotifera.
March, . .	291	140	93	57	63	54	54	39	Rotifera.
April, . .	350	283	201	126	56	84	95	73	Chlorophyceæ.
May, . .	562	249	127	43	75	80	80	54	Infusoria.
June, . .	1,037	245	226	67	61	62	65	63	Diatomaceæ. Cyanophyceæ. Infusoria. Rotifera.
July, . .	402	82	31	29	58	62	65	63	- -
August, . .	404	276	70	33	67	84	89	109	Cyanophyceæ.
September, .	118	48	21	28	51	50	76	61	- -
October, . .	73	66	96	58	41	39	38	43	- -
November, .	92	126	119	39	39	49	46	59	- -
December, .	85	88	69	17	29	34	30	24	- -
Mean, .	390	222	128	49	61	66	74	64	

Framingham Reservoir No. 2, 1900.

[Standard units per cubic centimeter.]

MONTHS.	Organisms.				Amorphous.				Principal Organisms in the Reservoir.
	Surface.	Mid-depth.	Bottom.	Inlet.	Surface.	Mid-depth	Bottom.	Inlet.	
January, . .	795	433	320	119	112	107	111	178	Infusoria. Rotifera.
February, .	338	242	222	56	88	79	117	125	- -
March, . .	88	68	55	75	58	68	72	47	- -
April, . .	221	179	164	149	104	101	110	77	- -
May, . .	679	450	390	283	106	105	115	83	Diatomaceæ. Infusoria. Rotifera.
June, . .	364	249	155	207	66	90	147	80	Diatomaceæ.
July, . .	854	648	363	145	84	112	119	100	Cyanophyceæ. Chlorophyceæ.
August, . .	949	874	748	1,099	121	162	261	140	Cyanophyceæ. Chlorophyceæ.
September, .	940	719	562	124	128	161	149	112	Cyanophyceæ.
October, . .	381	423	189	91	94	106	115	96	Cyanophyceæ.
November, .	123	35	60	53	43	38	38	44	- -
December, .	34	27	17	7	32	32	29	29	- -
Mean, .	481	365	270	201	86	97	115	93	

TABLE No. 33 — *Continued.*

Lake Cochituate, opposite Gate-house, 1900.

[Standard units per cubic centimeter.]

MONTHS.	ORGANISMS.			AMORPHOUS.			Principal Organisms.
	Surface.	Mid-depth.	Bottom.	Surface.	Mid-depth.	Bottom.	
January, . . .	3,569	3,694	3,088	194	251	308	Diatomaceæ. Cyanophyceæ. Infusoria.
February, . . .	1,374	1,444	1,295	175	162	178	Diatomaceæ. Cyanophyceæ. Infusoria.
March, . . .	1,576	1,457	1,305	141	160	178	Diatomaceæ. Cyanophyceæ. Infusoria. Rotifera.
April, ...	2,506	2,576	2,173	129	139	138	Diatomaceæ. Cyanophyceæ. Infusoria. Rotifera.
May, ...	2,884	2,545	1,603	149	164	194	Diatomaceæ. Infusoria. Rotifera.
June, ...	1,767	196	358	84	96	195	Cyanophyceæ. Infusoria.
July, ...	1,295	688	445	71	92	154	Cyanophyceæ.
August, . . .	1,422	1,269	310	86	86	265	Cyanophyceæ. Infusoria.
September, . . .	1,489	764	572	90	140	362	Cyanophyceæ. Infusoria.
October, . . .	1,005	370	339	86	172	388	Cyanophyceæ. Crenothrix.
November, . . .	1,081	742	441	59	53	132	Cyanophyceæ. Infusoria. Crenothrix.
December, . . .	1,123	1,017	920	44	54	93	Diatomaceæ. Cyanophyceæ. Crenothrix.
Mean, . . .	1,758	1,397	1,071	109	131	215	

Chestnut Hill Reservoir, 1900.

[Standard units per cubic centimeter.]

MONTHS.	ORGANISMS.					AMORPHOUS.					Principal Organisms in Chestnut Hill Reservoir.
	Surface.	Mid-depth.	Bottom.	Inlet (Sudbury Aqueduct).	Inlet (Cochituate Aqueduct).	Surface.	Mid-depth.	Bottom.	Inlet (Sudbury Aqueduct).	Inlet (Cochituate Aqueduct).	
January, .	-	-	-	99	-	-	-	-	134	-	- -
February, .	-	-	-	104	1,089	-	-	-	80	115	- -
March, .	-	-	-	175	1,119	-	-	-	111	136	- -
April, .	1,057	911	916	891	-	141	145	153	147	-	Diatomaceæ. Chlorophyceæ. Infusoria.
May, . .	477	595	429	582	-	114	117	145	163	-	Diatomaceæ. Chlorophyceæ. Infusoria. Rotifera.
June, . .	661	485	419	634	1,044	79	90	77	103	90	Diatomaceæ. Chlorophyceæ. Cyanophyceæ. Infusoria.
July, . .	1,451	1,234	399	1,412	1,280	101	151	193	187	106	Diatomaceæ. Chlorophyceæ. Cyanophyceæ. Infusoria.
August, .	1,497	1,290	672	646	1,843	95	107	146	170	104	Diatomaceæ. Chlorophyceæ. Cyanophyceæ. Infusoria.
September,	1,598	1,371	571	655	1,343	159	177	253	195	97	Diatomaceæ. Chlorophyceæ. Cyanophyceæ.
October, .	863	918	707	644	508	81	103	113	88	90	Diatomaceæ. Chlorophyceæ. Cyanophyceæ.
November,	596	601	497	558	1,119	60	61	59	67	61	Diatomaceæ. Cyanophyceæ. Infusoria.
December,	-	-	-	421	906	-	-	-	49	48	- -
Mean, .	1,025	926	576	568	1,139	104	119	142	125	94	

TABLE NO. 33 — *Continued.*

Outlets from Chestnut Hill and Brookline Reservoirs and Taps in Boston, 1900.

[Standard units per cubic centimeter.]

MONTHS.	ORGANISMS.					AMORPHOUS.				
	Effluent Gate-house No. 1, Chestnut Hill Reservoir.	Effluent Gate-house No. 2, Chestnut Hill Reservoir.	Gate-house, Brookline Reservoir.	Low-service Tap in Park Square, Boston.	High-service Tap in Mt. Vernon Street, Boston.	Effluent Gate-house No. 1, Chestnut Hill Reservoir.	Effluent Gate-house No. 2, Chestnut Hill Reservoir.	Gate-house, Brookline Reservoir.	Low-service Tap in Park Square, Boston.	High-service Tap in Mt. Vernon Street, Boston.
January, . .	165	-	105	85	108	116	-	106	76	93
February, . .	112	-	297	134	274	78	-	97	68	84
March, . .	250	-	686	306	430	98	-	111	306	430
April, . . .	951	845	1,180	729	799	146	158	146	112	109
May, . . .	525	414	379	505	405	121	138	120	124	111
June, . . .	683	624	504	340	336	100	77	70	146	78
July, . . .	1,239	1,545	988	628	508	110	128	92	121	104
August, . .	1,274	1,568	646	614	586	117	103	103	98	138
September, . .	1,419	1,211	462	734	444	209	140	118	127	118
October, . .	-	818	269	579	520	-	91	64	99	95
November, . .	-	589	140	477	470	-	70	53	59	57
December, . .	-	455	197	479	553	-	44	44	45	46
Mean, . .	735	897	488	468	452	122	105	94	97	95

Spot Pond, 1900.

[Standard units per cubic centimeter.]

MONTHS.	ORGANISMS.			AMORPHOUS.			Principal Organisms.	
	Surface.	Mid-depth.	Bottom.	Surface.	Mid-depth.	Bottom.		
January, .	41	142	55	89	206	137	-	-
February, .	50	20	13	159	84	134	-	-
March, . .	83	-	-	80	-	-	-	-
April, . .	284	274	348	155	166	291	-	-
May, . .	1,101	1,151	1,094	128	151	174	Diatomaceæ. Rotifera.	Infusoria.
June, . .	1,800	2,012	3,205	123	189	375	Diatomaceæ. Rotifera.	Infusoria.
July, . .	859	678	1,057	201	200	450	Cyanophyceæ.	Infusoria.
August, .	848	709	732	111	94	110	Diatomaceæ.	Cyanophyceæ.
September, .	399	383	311	138	157	168	Diatomaceæ.	Cyanophyceæ.
October, .	405	390	310	92	94	100	Diatomaceæ.	
November, .	433	412	479	57	64	66	Diatomaceæ.	
December, .	577	600	510	48	61	55	Infusoria.	
Mean, .	573	606	738	115	133	187		

The pond was used for supplying water to the District only for one week in March, and to a limited extent in December. Until August it was kept at a low level, on account of the work of improvement.

TABLE NO. 33 — *Concluded.*

Fells Reservoir, 1900.

[Standard units per cubic centimeter.]

MONTHS.	ORGANISMS.			AMORPHOUS.			Principal Organisms.
	Opposite Intake (Surface).	Near Intake (Surface).	Effluent Gate-house.	Opposite Intake (Surface).	Near Intake (Surface).	Effluent Gate-house.	
January, .	102	142	-	90	86	-	- -
February, .	73	118	-	69	59	-	- -
March, .	463	662	-	71	86	-	Infusoria.
April, . .	1,476	874	-	156	132	-	Diatomaceæ. Infusoria.
May, . .	831	777	-	125	125	-	Diatomaceæ. Infusoria.
June, . .	1,423	1,482	-	68	59	-	Diatomaceæ. Infusoria.
July, . .	796	795	-	106	112	-	Diatomaceæ. Cyanophyceæ. Infusoria.
August, .	667	777	-	106	120	-	Diatomaceæ. Cyanophyceæ. Infusoria.
September,	-	-	1,000	-	-	201	Diatomaceæ. Cyanophyceæ.
October, .	-	-	813	-	-	36	Diatomaceæ. Cyanophyceæ.
November, .	-	-	704	-	-	67	Diatomaceæ. Infusoria.
December, .	-	-	560	-	-	44	Diatomaceæ. Infusoria.
Mean, .	729	703	769	99	97	87	

TABLE NO. 34. — *Bacterial Examinations of Water from Various Parts of the Metropolitan Water Works, 1900 (Means of Weekly Determinations).*

[Number of bacteria per cubic centimeter.]

MONTHS.	CHESTNUT HILL RESERVOIR.							BROOKLINE RESERVOIR.	Tap in Park Square, Boston.	Tap at No. 2 Mt. Vernon Street, Boston.
	Surface.	Mid-depth.	Bottom.	Inlet (Sudbury Aqueduct).	Inlet (Cochituate Aqueduct).	Effluent Gate-house No. 1.	Effluent Gate-house No. 2.	Gate-house.		
January, . . .	-	-	-	145	-	81	-	123	78	105
February, . . .	-	-	-	540	135	244	-	216	266	279
March, . . .	-	-	-	563	211	466	93	360	312	321
April, ...	1,162	840	1,234	983	-	901	1,211	594	433	502
May, ...	169	316	419	243	-	208	292	265	223	124
June, ...	66	127	199	99	53*	76	57	69	188	145
July, ...	107	327	131	67	147	87	67	66	132	142
August, . . .	66	94	111	40	161	76	34	117	136	135
September, . . .	56	128	161	54	122	52	70	166	146	134
October, . . .	60	53	57	43	73	-	55	250	145	109
November, . . .	37	32	33	15	32	-	56	46	90	81
December, . . .	119	118	125	187	84	-	624	38	105	89
Mean, . . .	205	226	273	248	113	243	256	194	188	181

* One sample.

TABLE NO. 34. — *Concluded.*

Feeders of Lake Cochituate, 1900 (Means of Monthly Determinations).

[Temperature in degrees Fahrenheit; organisms and amorphous matter in standard units per cubic centimeter, and bacteria in number per cubic centimeter.]

	Temperature.	Organisms.	Amorphous.	Bacteria.
Beaver Dam Brook,	53.7	189	81	1,033
Beaver Dam Brook (last culvert),	54.9	143	82	630
Course Brook,	54.7	216	154	464
Dug Pond,	55.3	745	96	2,173
Circular Dam, at south end of lake,	55.1	122	61	2,846
Pegan Brook,	54.5	43	85	4,412
Snake Brook,	54.9	84	231	2,288

Brooks entering Sudbury Reservoir, 1900 (Means of Monthly Determinations).

	Color.	Organisms.	Amorphous.
Angelico Brook,	0.64	59	58
Brewers Brook,	0.54	32	44
Deerfoot Brook,	0.78	107	59
Rock Meadow Brook,	0.79	76	33
Brown Meadow Brook,	0.47	97	65
Broad Meadow Brook,	0.52	48	60

TABLE NO. 35. — *Colors of Water from Various Parts of the Metropolitan Water Works, 1900 (Means of Weekly Determinations).*

[Platinum standard.]

MONTHS.	NASHUA RIVER.	SUDBURY RESERVOIR.				FRAMINGHAM RESERVOIR NO. 3.			WHITEHALL RESERVOIR.
	Surface.	Surface.	Mid-depth.	Bottom.	End of Open Channel.	Surface.	Mid-depth.	Bottom.	Surface.
January,	0.47	0.43	0.42	0.41	0.48	0.39	0.38	0.38	0.67
February,	0.49	0.51	0.51	0.51	0.73	0.46	0.46	0.46	0.65
March,	0.39	0.46	0.46	0.46	0.42	0.46	0.46	0.46	0.53
April,	0.44	0.38	0.38	0.38	0.51	0.38	0.38	0.38	0.49
May,	0.55	0.31	0.31	0.31	0.58	0.32	0.82	0.32	0.57
June,	0.55	0.33	0.31	0.31	0.54	0.29	0.30	0.31	0.69
July,	0.47	0.30	0.31	0.32	0.46	0.29	0.30	0.31	0.69
August,	0.47	0.29	0.29	0.32	0.43	0.30	0.30	0.30	0.66
September,	0.39	0.25	0.25	0.26	0.38	0.26	0.28	0.41	0.62
October,	0.43	0.21	0.21	0.22	0.46	0.23	0.24	0.25	0.59
November,	0.57	0.27	0.27	0.28	0.64	0.23	0.23	0.23	0.66
December,	0.53	0.51	0.52	0.54	0.58	0.42	0.43	0.44	0.45
Mean,	0.48	0.35	0.35	0.36	0.52	0.34	0.34	0.36	0.61

TABLE No. 35 — *Continued.*

[Platinum standard.]

MONTHS.	HOPKINTON RESERVOIR.				ASHLAND RESERVOIR.				FRAMINGHAM RESERVOIR No. 2.			
	Surface.	Mid-depth.	Bottom.	Inlet.	Surface.	Mid-depth.	Bottom.	Inlet.	Surface.	Mid-depth.	Bottom.	Inlet.
January,	0.39	0.38	0.39	0.95	0.43	0.43	0.45	0.90	0.48	0.49	0.49	0.80
February,	0.49	0.49	0.52	1.00	0.57	0.57	0.58	1.03	0.72	0.73	0.74	0.76
March,	0.57	0.57	0.57	0.85	0.61	0.61	0.61	0.76	0.54	0.54	0.54	0.60
April,	0.54	0.54	0.55	1.25	0.58	0.59	0.58	1.04	0.64	0.64	0.64	0.79
May,	0.53	0.56	0.53	1.52	0.62	0.62	0.62	1.44	0.89	0.86	0.86	0.98
June,	0.60	0.58	0.56	1.65	0.67	0.66	0.64	1.51	0.97	0.97	0.96	1.09
July,	0.55	0.55	0.58	1.06	0.61	0.63	0.62	1.00	0.83	0.84	0.85	0.68
August,	0.53	0.53	0.53	0.61	0.58	0.61	0.61	0.52	0.60	0.62	0.65	0.55
September,	0.50	0.52	0.97	0.66	0.55	0.56	0.65	0.40	0.54	0.55	0.55	0.69
October,	0.43	0.45	1.14	0.96	0.45	0.47	0.49	0.61	0.55	0.56	0.56	0.62
November,	0.45	0.45	0.45	1.09	0.45	0.45	0.46	0.82	0.64	0.64	0.63	0.75
December,	0.43	0.53	0.56	1.23	0.54	0.54	0.56	1.16	0.94	0.93	0.93	0.91
Mean,	0.51	0.51	0.61	1.07	0.56	0.56	0.57	0.93	0.70	0.70	0.70	0.77

TABLE No. 35 — *Continued.*

[Platinum standard.]

MONTHS.	FRAMINGHAM RESERVOIR No. 1.	LAKE COCHITUATE.				SPOT POND.			FELLS RESERVOIR.		
	Surface.	Surface.	Mid-depth.	Bottom.	Influent Streams.*	Surface.	Mid-depth.	Bottom.	Opposite Intake (Surface).	Near Intake (Surface).	Effluent Gate-house.
January,	0.47	0.34	0.35	0.44	0.64	0.37	0.40	0.40	0.23	0.21	-
February,	0.68	0.30	0.31	0.32	0.69	0.36	0.36	0.39	0.22	0.21	-
March,	0.54	0.31	0.32	0.33	0.61	0.34	-	-	0.26	0.25	-
April,	0.59	0.28	0.29	0.30	0.71	0.29	0.29	0.30	0.32	0.32	-
May,	0.81	0.26	0.26	0.28	1.02	0.19	0.19	0.20	0.29	0.29	-
June,	0.88	0.25	0.26	0.53	0.92	0.16	0.16	0.17	0.27	0.27	-
July,	0.69	0.24	0.26	0.54	0.57	0.17	0.17	0.19	0.30	0.31	-
August,	0.52	0.25	0.33	0.98	0.46	0.19	0.19	0.20	0.31	0.31	-
September,	0.44	0.23	0.33	1.42	0.41	0.20	0.20	0.21	-	-	0.33
October,	0.45	0.20	0.29	1.91	0.46	0.17	0.18	0.19	-	-	0.26
November,	0.45	0.32	0·31	0.62	0.39	0.20	0.20	0.21	-	-	0.34
December,	0.90	0.26	0.29	0.36	0.50	0.18	0.21	0.22	-	-	0.30
Mean,	0.62	0.26	0.29	0.67	0.62	0.24	0.23	0.24	0.28	0.27	0.31

* The colors given in this column represent the combined colors of the water of the four principal feeders. The color of each is determined monthly, and due weight is given, in combining the results, to the sizes of the streams.

TABLE No. 35 — *Concluded.*

[Platinum standard.]

MONTHS.	CHESTNUT HILL RESERVOIR.							BROOKLINE RESERVOIR.		
	Surface.	Mid-depth.	Bottom.	Inlet (Sudbury Aqueduct).	Inlet (Cochituate Aqueduct).	Effluent Gate-house No. 1.	Effluent Gate-house No. 2.	Gate-house.	Tap in Park Square, Boston.	Tap at No. 2 Mt. Vernon Street, Boston.
January, ...	-	-	-	0.39	-	0.35	-	0.34	0.33	0.37
February, ...	-	-	-	0.48	0.30	0.42	-	0.38	0.42	0.43
March, ...	-	-	-	0.46	0.30	0.43	0.41	0.36	0.42	0.41
April, ...	0.38	0.38	0.38	0.39	-	0.38	0.38	0.36	0.36	0.36
May, ...	0.31	0.31	0.31	0.33	-	0.31	0.33	0.31	0.30	0.31
June, ...	0.33	0.33	0.32	0.35	0.26	0.32	0.32	0.30	0.31	0.31
July, ...	0.35	0.35	0.38	0.40	0.24	0.33	0.34	0.27	0.33	0.32
August, . . .	0.28	0.30	0.54	0.34	0.25	0.28	0.28	0.28	0.29	0.33
September, . .	0.31	0.31	1.13	0.36	0.25	0.30	0.31	0.33	0.31	0.35
October, . . .	0.26	0.27	0.28	0.35	0.19	-	0.27	0.26	0.29	0.27
November, . . .	0.33	0.34	0.36	0.40	0.27	-	0.34	0.25	0.37	0.32
December, . . .	-	-	-	0.43	0.29	-	0.36	0.24	0.37	0.36
Mean, . . .	0.32	0.32	0.45	0.39	0.26	0.35	0.33	0.31	0.34	0.35

TABLE No. 36. — *Temperatures of Water from Various Parts of the Metropolitan Water Works, 1900 (Means of Weekly Determinations).*

[The temperatures are taken at the same places and times as the samples for microscopical examination; the depth given for each reservoir is the depth from high-water mark where the temperatures are taken.]

[Degrees Fahrenheit.]

MONTHS.	NASHUA RIVER.	SUDBURY RESERVOIR (DEPTH AT PLACE OF OBSERVATION 54.5 FEET).				FRAMINGHAM RESERVOIR No. 3 (DEPTH AT PLACE OF OBSERVATION 20.5 FEET).			HOPKINTON RESERVOIR (DEPTH AT PLACE OF OBSERVATION 54.3 FEET).		
	Surface.	Surface.	Mid-depth.	Bottom.	End of Open Channel.	Surface.	Mid-depth.	Bottom.	Surface.	Mid-depth.	Bottom.
January, . .	33.2	34.0	35.3	35.9	33.3	34.5	35.3	36.6	34.1	36.6	37.8
February, . .	32.4	33.3	34.0	34.6	32.7	33.8	35.0	35.8	34.0	38.5	39.5
March, . . .	34.0	34.2	34.5	34.9	34.8	35.0	35.5	36.3	-	-	-
April, . . .	47.4	43.6	42.8	42.5	45.8	44.3	44.0	43.6	44.0	42.9	42.6
May, . . .	56.2	57.8	54.9	43.8	58.1	58.3	57.4	56.8	54.8	51.4	50.1
June, . . .	69.6	70.3	63.6	62.1	69.4	70.8	69.4	67.4	54.8	51.4	50.1
July, . . .	75.7	77.0	72.7	71.4	76.4	76.9	75.4	73.7	74.4	62.3	54.5
August, . .	77.3	75.4	73.8	73.2	73.9	75.3	74.6	74.0	75.4	64.2	55.4
September, . .	70.6	72.1	71.4	70.4	69.3	70.5	70.1	69.5	70.2	67.3	52.6
October, . .	59.1	60.3	59.9	59.4	56.1	58.8	59.2	59.5	59.0	58.9	51.0
November, . .	44.1	47.6	47.1	47.9	43.7	46.3	46.5	46.6	47.1	47.1	47.1
December, . .	34.8	33.9	35.2	36.0	34.3	35.9	36.4	36.7	37.0	37.1	37.1
Mean, . .	52.9	53.3	52.1	51.8	52.3	53.4	53.2	53.0	53.2	50.7	47.1

TABLE No. 36 — *Continued.*

[Degrees Fahrenheit.]

MONTHS.	ASHLAND RESERVOIR (DEPTH AT PLACE OF OBSERVATION 40.7 FEET).			FRAMINGHAM RESERVOIR No. 2 (DEPTH AT PLACE OF OBSERVATION 20.5 FEET).			LAKE COCHITUATE (DEPTH AT PLACE OF OBSERVATION 62.0 FEET).			WHITEHALL RESERVOIR.
	Surface.	Mid-depth.	Bottom.	Surface.	Mid-depth.	Bottom.	Surface.	Mid-depth.	Bottom.	Surface.
January, . .	35.9	37.3	38.3	33.9	35.0	35.9	37.1	38.0	38.5	35.5
February, .	35.8	37.0	37.8	33.8	35.0	35.9	36.0	36.6	37.7	36.5
March, . .	37.0	37.5	38.5	34.8	35.5	36.1	35.3	35.5	35.9	35.8
April, . .	44.3	43.3	42.6	45.7	45.2	44.9	42.7	41.1	40.5	47.5
May, . .	55.0	53.2	50.8	59.8	58.8	58.3	54.7	48.8	42.7	56.2
June, . .	55.0	53.2	50.8	72.4	70.5	68.3	70.6	52.8	43.8	56.5
July, . .	77.0	60.2	58.1	79.0	76.9	74.7	76.6	54.4	48.1	75.5
August, . .	76.5	65.3	53.2	75.1	74.3	73.3	76.0	55.1	48.6	76.3
September, .	70.9	67.3	53.5	70.3	69.8	69.4	71.2	50.3	44.9	68.9
October, . .	60.2	59.7	58.0	58.1	58.2	58.2	59.3	53.2	43.8	57.6
November, .	47.9	48.1	48.3	45.9	46.1	46.2	47.8	47.6	45.0	43.4
December, .	37.5	38.1	38.6	35.6	36.1	36.5	39.5	40.0	40.2	35.0
Mean, .	52.8	50.0	47.0	53.7	53.5	53.1	53.9	46.1	42.5	52.1

TABLE No. 36 — *Concluded.*

[Degrees Fahrenheit.]

MONTHS.	SPOT POND (DEPTH AT PLACE OF OBSERVATION 28.0 FEET).			CHESTNUT HILL RESERVOIR (DEPTH AT PLACE OF OBSERVATION 26.0 FEET).							BROOKLINE RESERVOIR.	Tap in Park Square, Boston.	Tap at No. 2 Mt. Vernon Street, Boston.
	Surface.	Mid-depth.	Bottom.	Surface.	Mid-depth.	Bottom.	Inlet (Sudbury Aqueduct).	Inlet (Cochituate Aqueduct).	Effluent Gate-house No. 1.	Effluent Gate-house No. 2.	Effluent Gate-house.		
January, .	34.5	36.0	37.5	-	-	-	37.1	-	36.4	-	36.9	37.0	38.5
February, .	34.0	37.5	39.0	-	-	-	35.6	37.5	34.8	-	35.6	35.6	37.5
March, .	33.9	-	-	-	-	-	36.3	36.9	35.8	38.0	36.5	36.3	37.3
April, .	45.0	44.4	45.3	45.1	43.4	42.6	44.6	-	45.1	45.3	45.4	44.6	45.2
May, . .	53.7	54.8	54.8	55.2	54.1	51.6	54.9	-	55.1	54.6	55.2	54.6	54.8
June, . .	69.2	69.7	67.7	65.0	64.1	53.4	63.7	56.5	65.7	66.5	66.9	64.6	64.9
July, . .	75.0	74.9	73.8	74.2	73.8	55.7	72.9	74.2	74.4	74.5	74.8	71.9	72.2
August, .	74.6	74.3	73.8	75.2	73.6	56.3	74.3	75.1	74.5	75.1	74.8	73.0	73.0
September,	69.8	69.5	70.8	72.6	70.2	64.6	71.0	71.7	71.5	71.8	71.3	70.4	71.0
October, .	58.7	58.4	58.4	60.7	60.2	59.9	59.9	60.4	-	60.9	60.9	60.6	61.5
November,	47.0	46.7	47.5	42.7	42.7	43.1	47.8	50.1	-	48.3	48.3	49.0	51.2
December,	36.2	38.5	38.0	-	-	-	37.9	40.6	-	37.4	38.4	39.6	40.7
Mean, .	52.6	55.0	55.1	61.3	60.3	53.4	53.0	55.9	61.5	57.2	58.8	53.1	54.0

TABLE NO. 37. — *Temperatures of the Air at Three Stations on the Metropolitan Water Works, 1900.*

[Degrees Fahrenheit.]

MONTHS.	CHESTNUT HILL RESERVOIR.			FRAMINGHAM.			CLINTON.		
	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.
January,	56.0	—5.5	28.4	58.0	—2.0	28.4	52.0	—4.5	24.4
February,	59.0	—4.0	28.0	58.0	—5.0	27.5	58.0	—7.0	23.7
March,	58.5	5.5	33.1	59.0	6.0	34.2	52.5	3.5	29.0
April,	81.0	24.5	47.1	80.0	24.0	47.7	75.0	23.5	45.3
May,	95.0	28.5	56.1	89.0	29.0	55.8	91.0	27.5	54.4
June,	96.0	38.5	68.2	93.0	37.0	69.2	91.5	39.5	67.5
July,	98.0	51.5	73.9	98.0	50.0	73.4	96.0	49.5	71.5
August,	98.0	50.0	71.9	96.0	47.0	70.4	93.0	46.0	70.0
September,	93.5	38.5	65.2	91.0	36.0	64.2	99.0	33.0	63.9
October,	81.0	80.0	56.8	82.0	30.0	55.4	79.5	27.5	55.9
November,	74.0	15.0	43.5	71.0	13.0	42.7	67.0	16.5	40.5
December,	55.5	6.0	30.8	57.0	3.0	30.4	55.0	1.0	28.1
Average,	-	-	50.3	-	-	49.9	-	-	47.9

TABLE NO. 38. — *Table showing Length of Main Lines of Pipes and Connections owned and operated by Metropolitan Water Board, and Number of Valves set in Same.*

	DIAMETER OF PIPES IN INCHES.													Totals.
	60	48	42	36	30	24	20	16	14	12	10	8	6	
Length owned and operated January 1, 1900 (feet),	-	122,457	8,075	46,110	27,359	34,407	48,070	53,826	26	13,022	473	800	868	355,493
Gate valves in same,	-	32	-	35	19	27	23	41	1	37	5	4	16	240
Air valves in same,	-	68	3	33	4	12	29	27	-	3	-	-	-	179
Length laid during 1900 (feet),	307	1,618	-	295	68	1,706	46	483	-	923	16	665	61	6,188
Gate valves in same,	-	1	-	3	-	3	-	4	-	5	-	-	-	16
Air valves in same,	-	1	-	-	-	-	-	3	-	1	-	-	-	5
Length taken during 1900 (feet),	-	561	-	139	475	5,002	4,835	576	-	5	-	-	-	11,593
Gate valves in same,	-	-	-	-	12	3	6	-	-	1	-	-	-	22
Air valves in same,	-	-	-	-	-	1	1	-	-	-	-	-	-	2
Length abandoned during 1900 (feet),	-	511	-	48	1,063	185	1,442	506	-	576	-	76	189	4,596
Gate valves in same,	-	-	-	1	4	-	-	1	-	-	-	-	4	10
Air valves in same,	-	2	-	-	-	-	-	3	-	-	-	-	-	5
Total length owned and operated January 1, 1901 (feet),	307	124,125	8,075	46,496	26,839	40,930	51,509	54,379	26	13,374	489	1,389	740	368,678*
Gate valves in same,	-	33	-	37	27	33	29	44	1	43	5	4	12	268
Air valves in same,	-	67	3	33	4	13	30	27	-	4	-	-	-	181

* 69.82 miles.

TABLE NO. 39. — *Statement of Cast-iron Hydrant, Blow-off and Drain Pipes laid to January 1, 1901, owned and operated by the Metropolitan Water Board.*

	DIAMETER OF PIPES IN INCHES.						Totals.
	24	16	12	8	6	4	
Length laid to January 1, 1900 (feet),	352	2,110	2,993	76	2,032	919	8,482
Length laid during 1900 (feet),	-	-	146	-	-	42	188
Length taken during 1900 (feet),	-	-	23	22	77	20	142
Total length in use January 1, 1901 (feet),	352	2,110	3,162	98	2,109	981	8,812
Valves set to January 1, 1900,	-	16	53	-	42	31	142
Valves set during 1900,	-	-	3	-	-	2	5
Valves taken during 1900,	-	-	1	-	2	2	5
Total valves in use January 1, 1901,	-	16	57	-	44	35	152

TABLE NO. 40. — *Length of Water Pipes, Four Inches in Diameter and Larger, in the Several Cities and Towns supplied by the Metropolitan Water Works.*

BY WHOM OWNED.	INCHES.																			TOTAL.	
	60	48	42	40	36	30	28	24	20	18	16	14	12	10	8	7	6	5	4	Feet	Miles.
Metropolitan Water Board.	307	124,125	8,075	-	46,496	26,839	-	40,930	51,509	-	54,379	26	13,374	489	1,389	-	740	-	-	368,678	69.82
Boston, . . .	-	33,671	16,813	23,104	39,984	84,193	244	79,382	93,623	-	168,141	-	1,072,139	86,690	520,946	-	1,436,122	-	102,140	3,757,192	711.59
Somerville, . .	-	-	-	-	-	-	-	-	3,596	387	2,071	8,037	67,261	41,198	87,569	-	184,933	-	22,843	417,895	79.15
Malden, . . .	-	-	-	-	-	-	-	-	-	-	-	13,023	61,578	20,860	63,407	-	180,139	-	93,979	432,986	82.00
Chelsea, . . .	-	-	-	-	-	-	-	-	-	-	2,348	-	-	37,883	25,815	-	122,677	-	12,381	201,104	38.09
Quincy, . . .	-	-	-	-	-	-	-	-	2,679	-	19,813	-	21,230	24,869	74,747	994	173,132	948	88,267	406,679	77.02
Everett, . . .	-	-	-	-	-	-	-	2,484	2,900	-	2,233	206	5,570	29,993	17,548	-	110,181	-	44,303	215,418	40.80
Medford, . .	-	-	-	-	-	-	-	-	1,972	-	6,775	9,585	23,482	27,842	62,398	-	79,470	-	61,464	272,988	51.70
Melrose, . . .	-	-	-	-	-	-	-	-	-	-	5,200	2,920	11,705	5,010	16,112	-	93,711	-	91,234	225,892	42.78
Revere,* . . .	-	-	-	-	-	-	-	-	-	-	24,000	4,450	3,300	7,950	15,043	-	58,792	-	65,181	178,716	33.85
Watertown, . .	-	-	-	-	-	-	-	-	-	-	400	12,127	5,959	4,169	18,861	-	101,568	-	13,239	156,323	29.61
Winthrop,* . .	-	-	-	-	-	-	-	-	-	-	-	-	-	5,000	19,176	-	19,144	-	72,867	116,187	22.01
Belmont, . .	-	-	-	-	-	-	-	-	-	-	-	-	2,161	11,102	12,896	-	66,331	-	283	92,773	17.57
Nahant, . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	11,550	-	-	28,840	-	38,125	78,515	14.87
Arlington, . .	-	-	-	-	-	-	-	-	-	-	-	-	27,644	21,066	26,476	-	65,407	-	34,043	174,636	33.08
Swampscott, . .	-	-	-	-	-	-	-	-	-	-	-	-	7,425	12,044	16,664	-	42,265	-	8,106	86,504	16.38
Total feet, .	307	157,796	24,888	23,104	86,480	111,032	244	122,796	156,279	387	285,360	50,374	1,322,828	347,715	979,047	994	2,763,452	948	748,455	7,182,486	-
Total miles, .	.06	29.88	4.71	4.38	16.38	21.03	.05	23.25	29.60	.07	54.05	9.54	250.53	65.86	185.43	.19	523.38	.18	141.75	-	1,360.32

* Pipes owned by Revere Water Company.

TABLE NO. 41. — *Number of Service Pipes, Meters and Fire Hydrants in the Several Cities and Towns supplied by the Metropolitan Water Works.*

CITY OR TOWN.	Services.	Meters.	Fire Hydrants.
Boston,	87,490	4,455	7,605
Somerville,	10,291	202	897
Malden,	6,548	3,176	393
Chelsea,	6,145	118	252
Quincy,	4,050	125	539
Everett,	4,405	34	365
Medford,	3,899	101	457
Melrose,	3,131	77	259
Revere,	1,932	13	117
Watertown,	1,577	1,425	301
Winthrop,	1,483	2	104
Belmont,	568	568	125
Nahant,	436	18	57
Arlington,	1,570	71	326
Swampscott,	971	-	116
Total,	134,496	10,385	11,913

APPENDIX No. 5.

SUMMARY OF STATISTICS.

REPORT FOR 1900.

The Metropolitan Water Works supply the Metropolitan Water District, which includes the following cities and towns: —

CITIES AND TOWNS.	Population, Census of 1900.
Boston,	560,892
Somerville,	61,643
Chelsea,	34,072
Malden,	33,664
Newton,*	33,587
Everett,	24,336
Quincy,	23,899
Medford,	18,244
Hyde Park,*	13,244
Melrose,	12,962
Revere,	10,395
Watertown,	9,706
Arlington,	8,603
Winthrop,	6,058
Belmont,	3,929
Nahant,	1,152
Total population of Metropolitan Water District,	856,886
Swampscott,†	4,548

* No water supplied to these places during the year from Metropolitan Water Works.

† Swampscott is not in the Metropolitan Water District, but has been supplied with water from the Metropolitan Water Works.

Sources of Supply.

SOURCE.	Area of Watershed (Square Miles).	Remarks.
Lake Cochituate,	18.87	Works built by city of Boston in 1848.
Sudbury River,	75.20	Works built by city of Boston in 1872-78.
Nashua River,	118.23	Works begun in 1895; not finished.

Mode of Supply.

32.4 per cent. from gravity works.
67.6 per cent. from pumping works.
After October 9 the entire supply was pumped.

Pumping.

Chestnut Hill High-service Station: —

Builders of pumping machinery, Holly Manufacturing Company, Quintard Iron Works and E. P. Allis Company.

Description of coal used: Bituminous; Georges Creek Cumberland and Loyal Hanna Sonman Shaft; anthracite coal screenings. Price per gross ton in bins: $3.67 to $4.78; screenings, $2.24. Average price per gross ton, $4.00. Per cent. ashes, 8.8.

Chestnut Hill Low-service Station: —

Builders of pumping machinery, Holly Manufacturing Company.

Description of coal used: Bituminous; Loyal Hanna Sonman Shaft. Price per gross ton in bins, $3.67 to $4.78. Average price per gross ton, $4.50. Per cent. ashes, 9.2.

Spot Pond Station: —

Builders of pumping machinery, Geo. F. Blake Manufacturing Company and Holly Manufacturing Company.

Description of coal used: Anthracite; bituminous and anthracite coal screenings. Price per gross ton in bins: bituminous, $4.48 to $6.60; anthracite, $5.04 to $5.32; screenings, $2.80 and $3.25. Average price per gross ton, $4 72. Per cent. ashes, 12.3.

	CHESTNUT HILL HIGH-SERVICE STATION.				
	Engines Nos. 1 and 2.	Engines Nos. 1 and 2 (Low-service).	Engine No. 3.	Engine No. 3 (Low-service).	Engine No. 4.
Coal consumed for year (pounds), . .	156,827	1,118,215	737,941	2,305,955	5,627,514
Cost of pumping, figured on pumping station expenses.	$778.39	$6,762.18	$3,130.31	$11,383.08	$23,490.36
Total pumpage for year (million gallons),	63.41	1,391.32	830.20	4,449.09	8,293.39
Average dynamic head, ...	125.08	48.70	123.26	52.08	125.34
Gallons pumped per pound of coal, .	404.33	1,244.23	1,125.02	2,128.81	1,473.72
Duty, on basis of plunger displacement,	43,990,000	52,700,000	119,110,000	95,230,000	155,420,000
Cost per million gallons raised to reservoir,	$12.276	$4.860	$3.771	$2.558	$2.832
Cost per million gallons raised one foot, .	0.098	0.100	0.031	0.049	0.023

	CHESTNUT HILL LOW-SERVICE STATION.	SPOT POND STATION.	
	Engines Nos. 5, 6 and 7.	Engine No. 8.	Engine No. 9.
Coal consumed for year (pounds),	3,779,657	2,295,878	325,681
Cost of pumping, figured on pumping station expenses,	$15,879.46	$9,278.37	$1,580.61
Total pumpage for year (million gallons),	9,431.14	1,728.10	287.03
Average dynamic head,	51.82	126.52	122.50
Gallons pumped per pound of coal,	2,495.24	752.70	881.32
Duty on basis of plunger displacement,	109,380,000	80,960,000	91,420,000
Cost per million gallons raised to reservoir,	$1.684	$5.369	$5.507
Cost per million gallons raised one foot,	0.032	0.042	0.045

Consumption.

Estimated total population of the fifteen cities and towns supplied wholly or partially during the year 1900,	815,400
Total consumption, gallons,	34,384,860,000
Furnished from Metropolitan Water Works sources, gallons,	34,343,790,000
Furnished from local sources, gallons,	41,070,000
Average daily consumption, gallons,	94,205,000
Gallons per day each inhabitant,	115.5

Distribution.

	Owned and Operated by Metropolitan Water Board.	Total Supplied by Metropolitan Water Works.
Kind of pipe used,	-*	-†
Sizes,	60 to 6 inch.	60 to 4 inch.
Extension less length abandoned, miles,	2.49	31.05
Length in use, miles,	69.82	1,360.32
Stop gates added,	28	-
Stop gates now in use,	268	-
Service pipes added,	-	1,766
Service pipes now in use,	-	134,496
Meters added,	-	154
Meters now in use,	-	10,385
Fire hydrants added,	-	297
Fire hydrants now in use,	-	11,913

* Cast-iron and cement-lined wrought iron. † Cast-iron, cement-lined wrought iron and kalamine.

APPENDIX NO. 6.

REPORT OF HAROLD PARKER, CHIEF ENGINEER OF THE ST. JOHN'S CATHOLIC CEMETERY ASSOCIATION, RELATIVE TO THE PREPARATION OF THE NEW ST. JOHN'S CATHOLIC CEMETERY, AND THE REMOVAL OF BODIES FROM THE OLD CEMETERY.

To the Trustees of St. John's Catholic Cemetery Association: Messrs. JOHN F. PHILBIN, W. H. FAY, J. F. DERVIN, P. A. S. GRADY, LAWRENCE FURY, and Rt. Rev. THOMAS D. BEAVEN and Rev. JOHN J. O'KEEFE, *Ex Officio*.

GENTLEMEN: — I herewith submit my report of the preparation of a new site for St. John's Cemetery, the removal of bodies thereto from the old cemetery in Clinton, and such other work as was entrusted to me, which was rendered necessary by the construction of the Wachusett Reservoir in Clinton.

By an official act of your Board, in February, 1899, I was appointed your chief engineer and my duties defined. I was instructed by that vote to prepare a plan of the new cemetery, the site for which had already been secured; to remove all bodies buried in the old cemetery, and place them in the new ground, in lots adjusted to their holdings in the old cemetery; to keep accurate record of all such removals; to adjust all questions arising with the owners of lots; and to superintend all work required to be done in connection with this undertaking.

Previous to this date (February, 1899) I had, under your approval, made surveys of the old and the new cemeteries. I had also outlined a plan by which the identity of the bodies could be preserved, and the location of each in the new cemetery fixed. This plan was subsequently perfected, and briefly is as follows: —

The old cemetery, or that portion of it used for burial purposes, was carefully surveyed and marked off on the ground into lots as nearly as possible to correspond with the indications in the cemetery, with such records as could be obtained, and deeds held by lot owners. These lots were then numbered and marked off into sections in the field. Charts were made corresponding to this lay-out on a scale of 5 feet equals 1 inch, about 20 inches by 30 inches, printed in white and pasted on strong straw board, the purpose of this being that the inspectors on the ground during the progress of removal of bodies could draw upon each chart the exact position of each body as it was taken out. The same process was employed in the new cemetery, after it had been laid out in accordance with plans approved and adopted by your Board. Books were prepared, upon each page of which were blanks to be filled out by the inspectors in the old cemetery, recording the section, the number of lot and number of grave of every body exhumed, with date of removal, and also the exact point in which each body was to be placed in the new cemetery. By a system of triplicating, the inspector made three copies of each removal at the time of removal, one of which remained in the book kept by him, and the other two were handed to the driver of the hearse conveying the body to the new cemetery; one to be delivered by the driver to the inspector in the new cemetery, with the body corresponding thereto, the same record being painted upon the box containing the remains, and the third copy to be delivered by the driver to the contractor. The inspector in the new cemetery was required to hand in all the slips received by him with each body to the clerk in the office each night, and they were by the clerk recorded in a book especially prepared. By this means you will perceive that the identity of no body could be lost, even if it were unclaimed or unrecognized. I had, previous to the removal of bodies, assigned a lot in the new cemetery for every lot in the old cemetery, and had the corresponding numbers marked on the charts used by the inspectors in the old cemetery. I also required the inspector in the new cemetery to graphically represent the position of the body on his chart; so that I had at any time a complete record of the exact point from which each individual body came, and the exact point in which it was reinterred. This enabled me to find and restore to their relations many remains of persons unclaimed at the time of removal.

Previous to the commencement of removal I was required to prepare a contract under which that part of the work was to be done. This contract was based upon all the information I could obtain in relation to work of this kind, and was submitted for approval to your Board and to the Metropolitan Water Board. A copy of this contract is submitted with this report.

I have thus given you an outline of the preparation necessary, as I thought, to successfully accomplish the results required. As to their operation, I have to report as follows: —

The contract for removing bodies, headstones and other appurtenaces was let, after some difficulties which it is unnecessary for me to detail, to Martin Murphy of Clinton, at the following prices: —

Bodies,	$4 66⅔
Monuments,	12 50
Headstones,	4 50
Curbings (whole number),	2,500 00

Mr. Murphy was peculiarly well fitted to do this work, as he had long officiated as undertaker, and was better acquainted with the burials in the cemetery than any other person. He also enjoyed the confidence of the people, which in a case of this sort is of vast importance. Mr. Murphy was put under bonds for the faithful performance of his contract, which he has redeemed in a highly satisfactory manner.

Under the plan of operation adopted, certain inspectors were required for each cemetery. It was understood that all appointments made by your Board, who were to serve during the process of removal, were to be subject to my approval. The following persons were so appointed: —

Chief inspector, William F. O'Toole. His assistants in the old cemetery were John Monahan and T. F. Magee. In the new cemetery, Mr. Henry McQuaid, with a little help, performed the duties of inspector. Mr. John S. Scully has acted as clerk, with the exception of a short period at the commencement, when Mr. T. F. Magee was the incumbent. I wish to say of each of these gentlemen that they have done their work carefully and faithfully, and have always lent me their cheerful aid in matters often delicate and difficult. Mr. O'Toole especially, as chief inspector, has been in a position where firmness and fairness, as well as tact, were absolutely requisite, and without them it is hard to see how this work could have been successfully accomplished.

The work of removal was begun December 19, 1899, and at a point almost diametrically opposite from that which I had designed. This was due to the fact that the Metropolitan Water Board desired to clear a space along the face of the North Dike. Enough bodies were removed from this section to satisfy the needs of the Metropolitan Water Board, and work was then suspended until April 2, 1900, at which time it was resumed and prosecuted to its completion. The contract under which Mr. Murphy worked required all bodies to be removed by July 1, 1900; but, with the consent of all parties interested, this time for completion was extended until September 1, 1900, at which time all removals had taken place, except a few isolated bodies of which no records or traditions existed, and since then some have been discovered by the contractors on the Wachusett Reservoir, in stripping.

The contractor has in all respects obeyed the instructions of your engineer in the interpretation of the terms of the contract, and could, so far as he alone was concerned, have completed his work at the specified time.

In the removal of bodies I have frequently permitted the placing of more than one body in a box, but never without the expressed wish of the proper parties, and in the presence of at least one of those interested. In all these cases the remains found were almost completely disintegrated, and the purpose was to economize room in the new lots.

The removal of all these bodies, 3,816 in number, has been accomplished, so far as I am aware, without one single case of serious dissatisfaction.

Many questions have arisen from time to time, as was inevitable, but they have always been settled without lasting discontent.

All headstones, footstones and corner-stones have been reset in the new cemetery with great care upon foundations five feet deep, laid in cement mortar. Curbings, by act of your Board, have been excluded from the new cemetery, under an agreement with the owners. This, however, was not under my supervision; and is only mentioned as incidental to the work done by me.

In regard to the preparation of the territory for the new cemetery, I have to say that it was originally purchased for the purpose by Messrs. McNamara & Murphy, and was turned over by them to the Commonwealth of Massachusetts (Metropolitan Water Board), by whom it is still held, to be transferred to St. John's Catholic Cemetery Association when final settlement is made. This land, comprising 67.43 acres, was completely covered with wood and timber when purchased, and that portion occupied by the new cemetery and the drives through the remaining portion had to be cleared and grubbed at very considerable cost; but, when done, its beautiful location and the nature of the soil show the wisdom of the choice. The plan as adopted by your Board has been laid out on the ground. One main drive extends the entire length of the territory, and others have been constructed through the unoccupied portions; so that the general plans have been indicated beyond those parts now or in the near future to be used, and additional lots can be laid out from time to time, as required, on the same lines as were originally devised. Iron pins have been adopted for marking the corners of the lots, and iron disks have been made to designate each lot, to be placed in the centre of the lot.

The area occupied has been graded in such a way as to care for the surface water, and to remove it from the drives in the proper places; it is not, however, claimed that this is complete. It is so arranged that additional catch-basins can be made to connect with these drain pipes now laid, as necessity may indicate.

The process of grading and surfacing is now nearly complete, and the entire surface has been covered with several inches of good loam, which had been previously piled up as it was removed from the roads and drives. This work could not be undertaken until after all the interments were made, as will be readily apparent, and this has been done under the care of your chairman, Mr. John F. Philbin.

During the preparation of the land there have been cut and sold 151.2 cords of wood, 4,000 feet of lumber and about 700 posts; 7,470 feet in length of roads have been graded and built, of which 3,860 feet have been macadamized; 675 feet of drain pipe have been laid; 5 catch-basins have been built; 23 acres of land have been cleared and grubbed.

I have thus stated to your Honorable Board the general facts and conditions that have existed previous to and during the operation of the work which you have entrusted to me. I have not gone into very minute details, as it appears to me to be uncalled for in this report. The records as kept, charts, plans, the financial accounts and all other minutiæ attached to my office are kept within the safe in your office, and are, and have been, accessible to you at all times.

The work of grading that was outside of contract work has been under the immediate charge of Festus McCann, foreman, who has faithfully, conscientiously and successfully carried out the instructions received by him.

Appendix.

I append hereto the following forms used during the progress of the work: —

No. 1 is blank form of certificate, to be surrendered for deed.

No. 2 is blank form of order to contractor for bodies to be sent out of town.

No. 3 is blank form of notice of removal and reinterment.

No. 4 is blank form of sheet in inspector's record.

No. 5 is blank form of contract.

HAROLD PARKER,
Chief Engineer, St. John's Catholic Cemetery Association.

APPENDIX No. 7.

SPECIAL REGULATIONS OF THE METROPOLITAN WATER BOARD, RELATIVE TO THE CUTTING AND REMOVAL OF ICE FROM THE SUDBURY RESERVOIR AND THE OPEN CHANNEL OF THE WACHUSETT AQUEDUCT.

The following special regulations were made by the Metropolitan Water Board on November 20, 1900, under and pursuant to Rule 15 of the rules made by the State Board of Health on June 1, 1899, for the sanitary protection of waters used by the Metropolitan Water Board for the water supply of cities and towns in the Metropolitan Water District, under the authority of chapter 488 of the Acts of the year 1895, and also under and pursuant to the general powers and authority given to the Metropolitan Water Board by said chapter and otherwise, and it was deemed by the Board that these regulations are necessary for the preservation of the purity of the water of the Sudbury Reservoir.

I.

Any inhabitant of the town of Southborough desiring to cut or remove ice from Sudbury Reservoir for his individual use only in said town, shall make application to the assistant superintendent of the Metropolitan Water Works, resident at South Framingham, personally or by letter, at least four days before the cutting of any ice. All applications shall state whether it is the intention to use horses or other animals in the cutting of ice.

(*a*) Ice shall be cut only in such places as shall be designated in the permit given.

(*b*) No horses or other animals shall be used upon the ice, except in accordance with special permission stated in the permit.

(*c*) In case permission is given to use horses or other animals, the entrance upon and departure from the ice shall be made only at such places as shall be specified in the permit.

(*d*) All manure and other refuse matter shall be thoroughly scraped up and immediately removed from the surface of the ice, and shall be deposited on land at such distance that it shall not be washed into the water.

(*e*) No matter tending to pollute the water shall be taken or left upon the ice or thrown into the water.

(*f*) All operations connected with the cutting of ice shall be carried on in such manner as not to injure the shores, paving, riprap, gravel margin or other land or property belonging to the Commonwealth.

(*g*) All persons cutting ice shall be subject to such special instructions as may be given by the officers or agents of the Metropolitan Water Board.

II.

Any riparian owner abutting on the open channel of the Wachusett Aqueduct, so called, in the town of Southborough, which channel extends from the covered portion of the aqueduct to the lower dam near the Sawin's Mill Road, so called, desiring to cut and remove ice from the channel for his individual use only, shall make application to the engineer of the Dam and Aqueduct Department of the Metropolitan Water Works, resident at Clinton, Mass., personally or by letter, and obtain permission therefor before the cutting of any ice. All applications shall state whether it is the intention to use horses or other animals in the cutting of ice.

(*a*) Ice shall be cut only in such places as shall be designated in the permit given.

(*b*) No horses or other animals shall be used upon the ice, except in accordance with special permission stated in the permit.

(*c*) In case permission is given to use horses or other animals, the entrance upon and departure from the ice shall be made only at such places as shall be specified in the permit.

(*d*) All manure and other refuse matter shall be thoroughly scraped up and immediately removed from the surface of the ice, and shall be deposited on land at such distance that it shall not be washed into the water.

(*e*) No matter tending to pollute the water shall be taken or left upon the ice nor thrown into the water.

(*f*) All operations connected with the cutting of ice shall be carried on in such manner as not to injure the shores, paving, riprap, gravel margin or other land or property belonging to the Commonwealth.

(*g*) All persons cutting ice shall be subject to such special instructions as may be given by the officers or agents of the Metropolitan Water Board.

[Rule 15 of the rules made by the State Board of Health referred to above is as follows: "No person shall enter upon the Wachusett Reservoir, so called, Sudbury Reservoir, the open channel of the Wachusett Aqueduct, Hopkinton Reservoir, Ashland Reservoir, Framingham Reservoir No. 1, Framingham Reservoir No. 2, Framingham Reservoir No. 3, Farm Pond, Whitehall Reservoir, Lake Cochituate, Spot Pond, Chestnut Hill Reservoir or any other lake, pond or reservoir used by the Metropolitan Water Board as a source, or for the conveyance, storage or distribution, of the water supply of any city, town, or water company, under the provisions of chapter 488 of the Acts of the year 1895, and acts in amendment thereof or addition thereto, for the purpose of cutting or taking ice, or cut or take ice from any such lake, pond or reservoir, without a written permit, signed by the Metropolitan Water Board, stating the time and place for which such permission is given."]

APPENDIX No. 8.

LEGISLATION OF THE YEAR 1900 AFFECTING THE METROPOLITAN WATER BOARD.

[Chapter 108.]

AN ACT TO EXTEND THE TIME FOR FILING PETITIONS FOR DAMAGES AND OFFERS OF SURRENDER OF REAL ESTATE, UNDER THE ACT TO PROVIDE FOR A METROPOLITAN WATER SUPPLY.

Be it enacted, etc., as follows:

1899, 342, § 1, amended.

SECTION 1. Section one of chapter three hundred and forty-two of the acts of the year eighteen hundred and ninety-nine is hereby amended by inserting after the word "determination", in the tenth and eleventh lines, the words: — of damages for the taking of water rights where no land is taken in connection with such water rights, and for the determination, — and by inserting after the word "acts", in the eleventh line, the words: — and offers of surrender of real estate provided for in said acts, — so as to read as follows: — *Section 1.* Petitions under the provisions of section fourteen of chapter four hundred and eighty-eight of the acts of the year eighteen hundred and ninety-five, or of section one of chapter four hundred and forty-five of the acts of the year eighteen hundred and ninety-seven, and acts in amendment thereof or in addition thereto, for the determination of damages for the taking of real estate may be filed, as provided by law, within two years after the actual taking by right of eminent domain of such real estate or of any interest therein, and petitions for the determination of damages for the taking of water rights where no land is taken in connection with such water rights, and for the determination of all other damage provided for in said acts, and offers of surrender of real estate provided for in said acts, may be filed on or before the first day of July in the year nineteen hundred and one.

Time within which certain petitions for damages, etc., may be filed extended.

Certain provisions of the law, etc., not affected.

SECTION 2. This act shall not affect the provisions of chapter five hundred and fifty-seven of the acts of the year eighteen hundred and ninety-eight, and shall not extend the time for filing petitions for damages for the taking of land with which no water rights are connected, or for the taking of land with which water rights are connected when both such land and the water rights connected therewith are taken.

SECTION 3. This act shall take effect upon its passage. [*Approved February 23, 1900.*

[Chapter 340.]

AN ACT TO AUTHORIZE THE METROPOLITAN PARK COMMISSION TO MAKE RULES AND REGULATIONS TO GOVERN THE PUBLIC USE OF THE CHARLES, NEPONSET AND MYSTIC RIVERS, AND OF PONDS AND OTHER WATERS ALONG WHICH IT HOLDS ABUTTING LANDS FOR PUBLIC OPEN SPACES.

Be it enacted, etc., as follows:

Metropolitan park commission may make rules, etc., to govern public use of certain rivers, etc.

SECTION 1. The metropolitan park commission may from time to time make rules and regulations to govern the public use of the Charles river, the Neponset river, and the Mystic river, within the metropolitan parks district, and of the ponds and other waters along which it holds abutting lands for public open spaces in said district, and for breaches thereof may affix penalties not exceeding twenty dollars for one offence, to be imposed by any court of competent jurisdiction; and in general may do all acts needful for the proper execution of the powers and duties granted to and imposed upon said board by this act: *provided*, that any rule or regulation affecting waters used for water supply purposes shall not take effect as to such waters until approved in writing by the water board or other officers of the state, district, city or town having control and charge of the same.

Proviso.

Certain rights of cities, towns, etc., not affected.

SECTION 2. Nothing in this act shall affect the rights of any city or town relating to its water supply, or the water rights of any person or corporation, whether a mill owner or otherwise.

SECTION 3. This act shall take effect upon its passage. [*Approved May 23, 1900.*

[Chapter 375.]

AN ACT RELATIVE TO THE CONSTRUCTION OF THE METROPOLITAN WATER WORKS.

Be it enacted, etc., as follows:

1895, 488, etc., to include construction, etc., of certain aqueduct, etc.

SECTION 1. Chapter four hundred and eighty-eight of the acts of the year eighteen hundred and ninety-five and acts in amendment thereof or in addition thereto shall be held to include the construction, maintenance and operation of an aqueduct from the so-called Sudbury reservoir in Southborough to a point in the town of Weston, of a reservoir near the end of such aqueduct, and of pipes for connecting such aqueduct or reservoir with distributing pipes, reservoirs and other works under the control of the metropolitan water board, substantially in accordance with the plans and recommendations of the state board of health contained in their report to the general court of the year eighteen hundred and ninety-five.

SECTION 2. This act shall take effect upon its passage. [*Approved June 8, 1900.*

[Chapter 469.]

AN ACT RELATIVE TO THE EMPLOYMENT OF LABORERS ON PUBLIC WORKS.

Be it enacted, etc., as follows ·

Employment of laborers on public works.

SECTION 1. No person or corporation, and no agent or employee of any person or corporation, under contract with the Commmonwealth or any municipal corporation or any county therein, or with any board, commission or officer acting on behalf of the Commonwealth or any county or municipal corporation therein, for the doing of public work, shall, either directly or indirectly, make it a condition of the employment of any person that he shall lodge, board or trade at any particular place or with any particular person; but every employee in such work shall have full liberty to lodge, board and trade wheresoever and with whomsoever he may choose.

Provisions of act to be part of contract.

SECTION 2. It shall be the duty of every board, commission or officer contracting as aforesaid, to make the provisions of this act a part of the contract.

Penalty.

SECTION 3. Any person who violates the provisions of this act shall be punished by fine not exceeding one hundred dollars for each offence. [*Approved July 17, 1900.*

[Chapter 470.]

AN ACT RELATIVE TO THE WEEKLY PAYMENT OF WAGES BY THE COMMONWEALTH AND ITS OFFICERS.

Be it enacted, etc., as follows:

1894, 508, § 51, to apply to Commonwealth.

The provisions of section fifty-one of chapter five hundred and eight of the acts of the year eighteen hundred and ninety-four, relative to the payment of weekly wages, as far as applicable to the cities of the Commonwealth, shall apply to the Commonwealth, and its officers, boards and commissions, when acting as employers of mechanics, workmen and laborers. [*Approved July 17, 1900.*

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